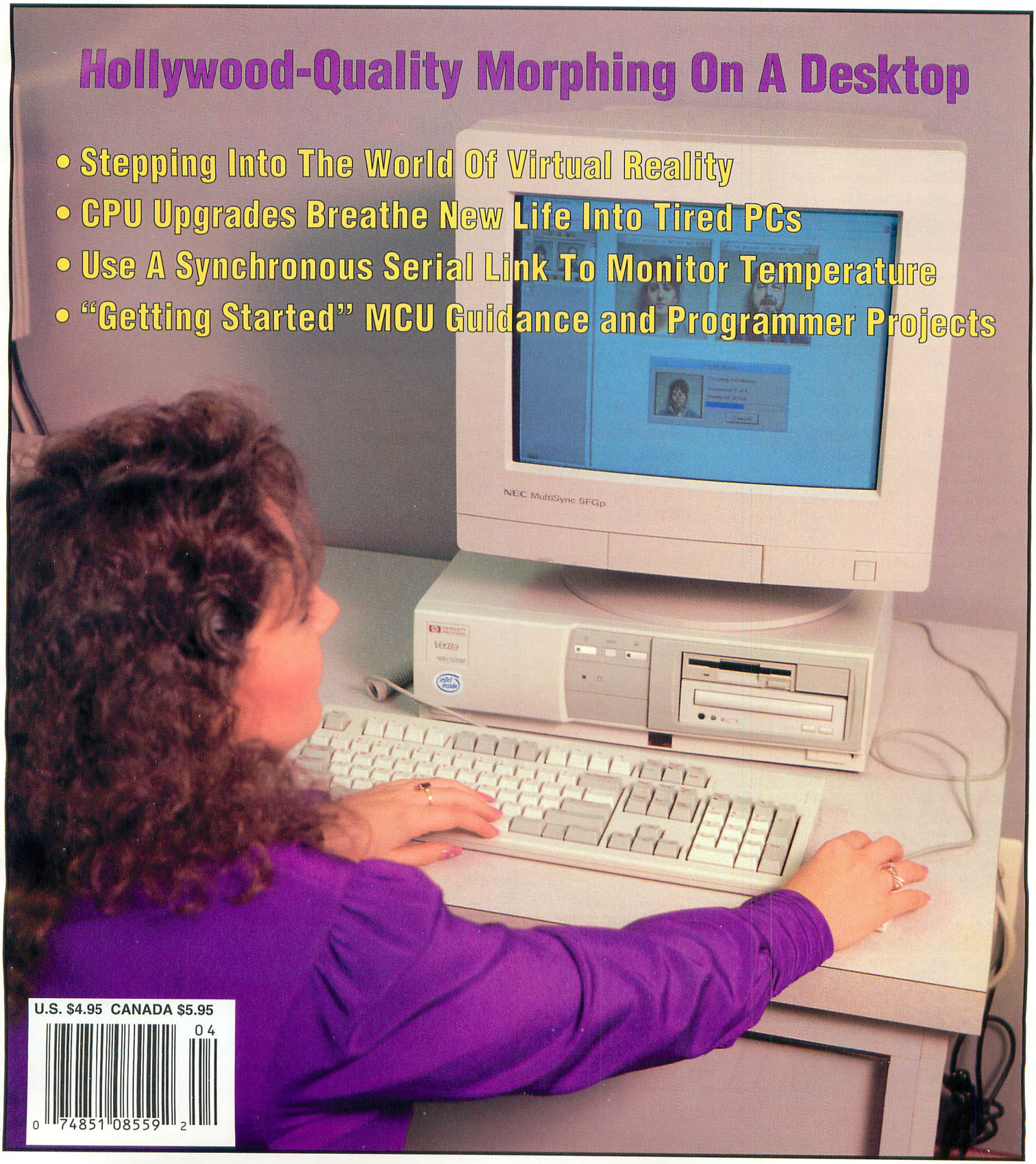
MicroComputer JOURNAL

The print forum for the MicroComputer professional and semi-professional

March/April 1995



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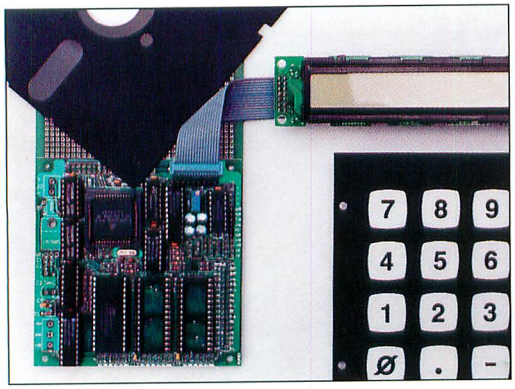

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The NMIT-0020 Single Board Computer is perfect for dedicated controller with convenient interfaces for LCD displays and keypad. Intelligent LCD's up to 2 lines by 80 characters and matrix keypads up to 4x5 can be used. The processor is the popular F68HC11 with many features, including SCI and SPI serial channels, 8-bit 8-ch. A/D, 20 available I/O lines, Watch Dog Timer, 1/2K EEPROM and Max-FORTH w/Floating Point Package embedded in 12K internal ROM. SBC expands F68HC11 providing 3 28-pin JEDEC sockets for 8-32K RAMs, ROMs, EPROMs, EEPROMs, etc. RS-232 conversion supplied. Requires external regulated supply: 5V at ~30 mA. Based on NMIX-0020 board, so, many features may be added as desired by the user (or by factory - fully configured NMIX-0020 Ad-special available @ $145, call for details).

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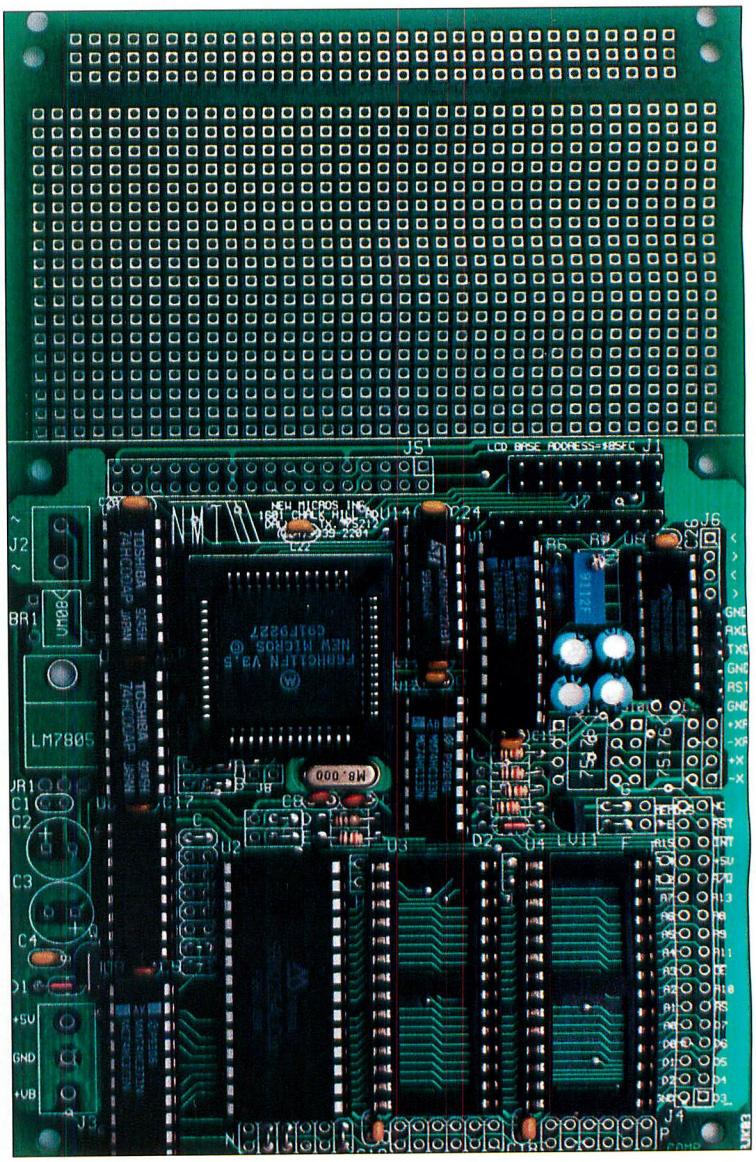
SBC and utility disk - $99. (Keypad and LCD not included. Available separately.) Great value. Call today! New Micros, Inc. Tel: 214-339-2204, Fax: 214-339-1585.



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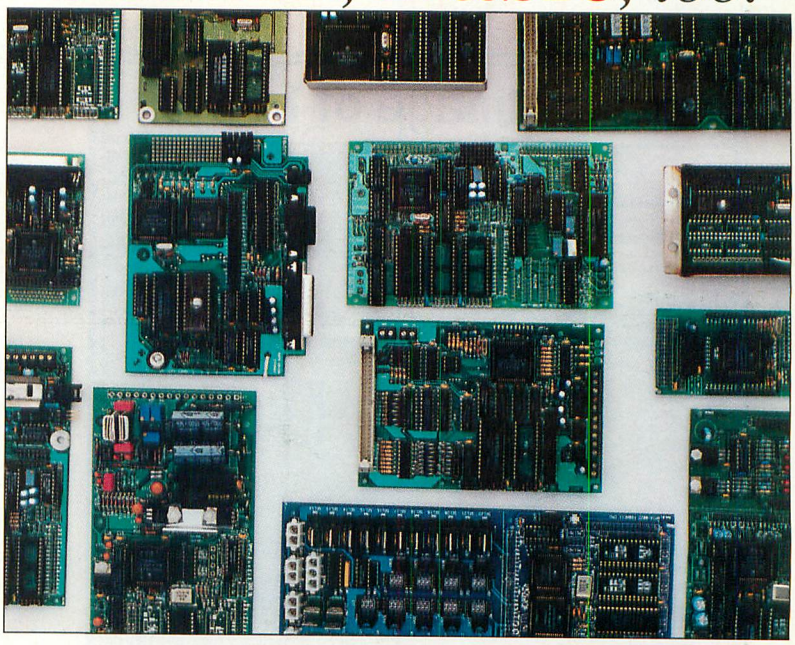

These controllers have been quite a hit. Thousands have been sold, just as seen in the picture on the facing page. Did you know, these boards *can* be customized?

Whether it is adding a feature to the NMIT-0020 (target version) to make it closer to the NMIX-0020 (development version), or, a complete redesign to meet a specific form-factor and function, even a different CPU, you should take advantage of the customization New Micros offers.

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Some customers asked for A/D and D/A features on the basic NMIT-0020 design. A/D and D/A cards were already available for use with the NMIT-0020's Vertical Stacking Connector, but the customers wanted a single board solution. No problem. We made the board to sell as a standard product, so, in this case, engineering charges were waved. The customers got what they wanted. Great!

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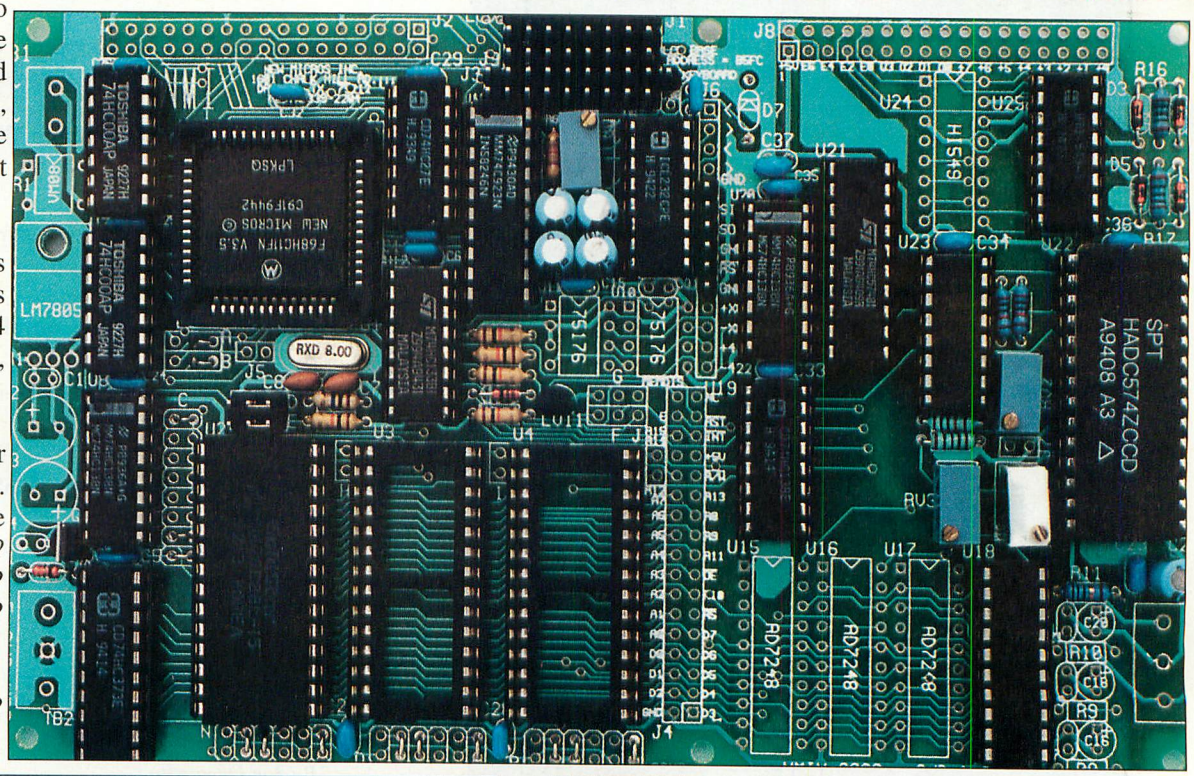

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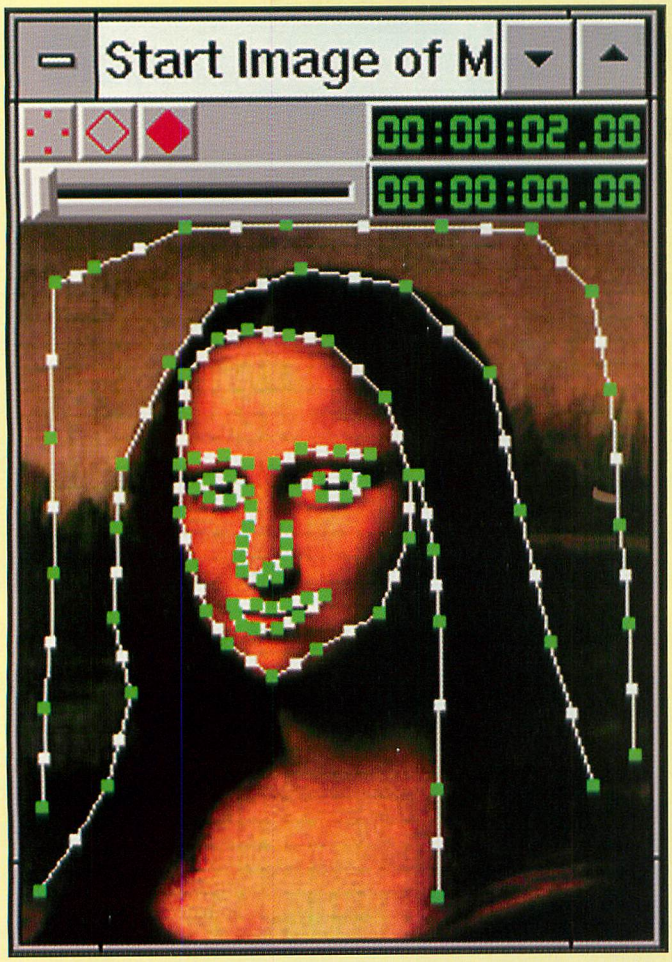
MicroComputer JOURNAL

Volume 2, No. 2, March/April 1995



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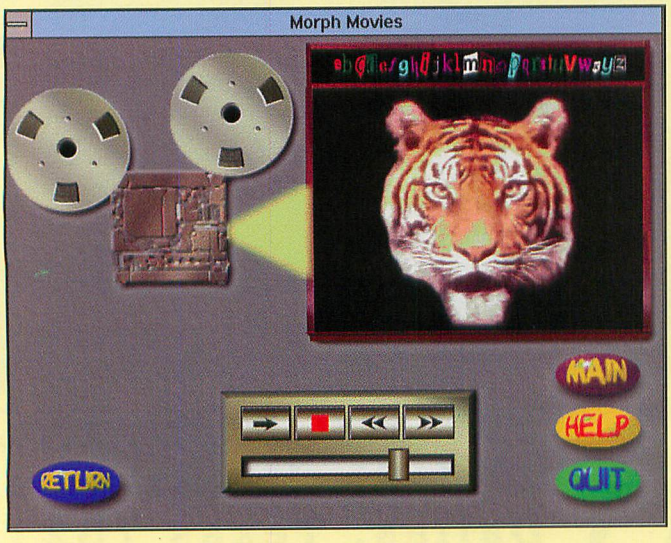

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Features

Product Reviews

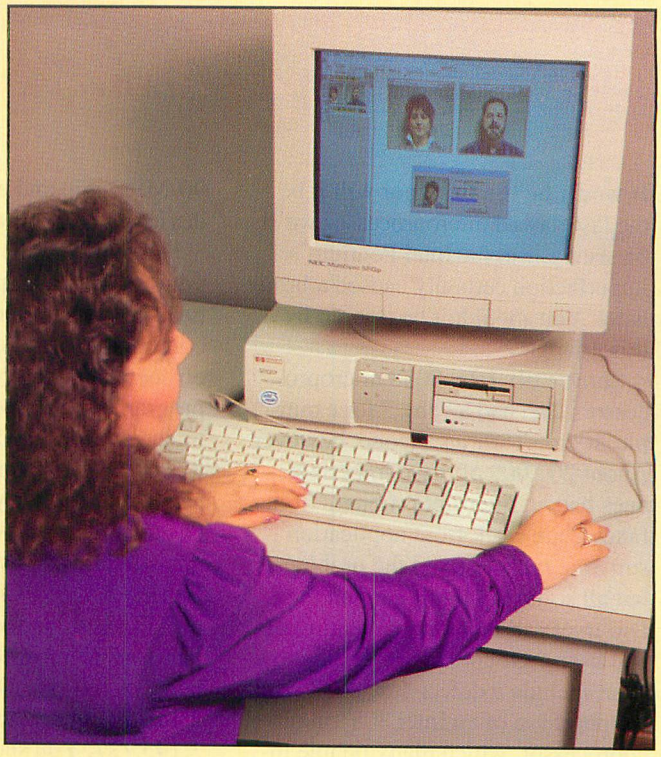
Columns

Departments

In This Issue

If the use of morphing dazzled you in *Terminator 2* and *The Abyss*, you'll probably be ecstatic at being able to do the same sort of things right on your desktop. To get in on the action, as illustrated in the photo on the cover, you need a fairly powerful PC—at least a 486DX2—and the right software. In "Morphing Demystified" on page 36, Tom Benford spells out what morphing is and reviews four morphing software packages for your consideration.

Virtual reality is another cutting-edge technology about which we're certain to hear a great deal more in the future. With it, you can step into and react to worlds that exist only in the minds of their creators and wholly in cyberspace. Cutting through the hype in the popular media, Hardin Brothers details what's available and what you need to get started exploring this fascinating technology in "Virtual Reality on the Desktop" on page 20.



If your interest is in microcontrollers, turn to Wallace Blackburn's "Getting Started With the MC68HC705K1 Microcontroller" on page 13 and Fred Eady's "Getting to Know the PIC17C42" on page 25. Both authors give details for building programmers for the respective MCUs.

Beginning on page 43, Jan Axelson gives the lowdown on "Temperature Monitoring With s Synchronous Serial Link." It's done with Dallas' DS1620 programmable digital thermometer and thermostat chip.

If you're working with a 286, 386 or 486 PC that seems sluggish, you can pep it up with a CPU upgrade to boost performance into the nether regions of 486 power—all the way to 100-MHz 486DX4 performance, depending on the CPU your PC now has. In "CPU Upgrades: The Complete Story" on page 53, TJ Byers details what options are available for boosting performance, benefits accrued and what an upgrade will cost you.

In the September/October 1994 issue, Emerson M. Hoyt presented one way to DISKCOPY between two dissimilar floppy disks. In "Use a .BAT File to Copy Dissimilar Disks Revisited" beginning on page 64, readers John L. Hultgren and Jason Fawcett offer two more views on this topic.

On page 68, Joe Desposito reviews FTG Data Systems' Pen Direct for Windows, which provides an alternative to a mouse. Then on page 73, Tom Fox reviews *LogicLab Explorer*, a software-simulated digital circuit breadboarding system.

In Computing On the Go (page 77), Joe Desposito relates his experiences in putting together a workgroup for peanuts and a great buy on an active-matrix-display ultra-portable PC. Tom Benford talks about morphs on CD-ROM and mixing and outputting computer video to TV or video tape in Multimedia (page 80). TJ Byers answers reader questions in Microcomputer Q&A (page 87). Yacco gives useful tips on tuning *Windows* in GUI Guts (page 92). Finally, John Hastings gives you the latest news on the PC front and representative examples of prices for used computer equipment.

Cover Photo By Joe Abbato/The Photography Place

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Editorial By Art Salsberg

The Case of the Pentium Flaw

It won't be the first, nor will it be the last flawed microprocessor we'll be seeing. But the Intel Pentium's imperfection certainly caused a brouhaha. You shouldn't be floored by this, though.

Some early Intel 8088 microprocessors also had a "bug," for example. It didn't stir up anyone, however. About 200,000 of these imperfect ones had an interrupt problem. Some fancy code work from application software makers fixed the problem, but all software didn't contain the fix. Did Intel call this to the attention of end users? Of course not. It did, however, include a defect-free 8088 with the purchase of an Intel 8087 math coprocessor, which many people inferred were "matched pairs" for greater accuracy. You could identify the flawed chip with some diagnostic programs as: 8088 (c)Intel 1978. Bug-free ones had '81 or '83 appended to the '78 copyright mark.

Even early Intel 80386 microprocessors were flawed, causing the system to lock up at times if running 32-bit code (which only a small percentage of users did). Intel recalled these microprocessors from vendors. Returned ones, whatever fraction they were of the original number shipped, were then stamped to identify the microprocessors as for use only with 16-bit programs: 80386-16 16-bit SW only. They were sold to bargain merchandisers, but some machines got out there with flawed 80386 microprocessors. In innocent end-user hands, power-line glitches were blamed for many hang-ups caused by these installed chips. So were programs thought to be flaky.

Chips without this flaw were labeled: 80386-16 ΣΣ. Intel played this one close to its vest, too.

Now we have flawed Pentium microprocessors, all the way up to 100-MHz devices. Checking this out early on with Intel, I asked if it weren't wiser at this time to buy a 90-MHz chip instead of a 100-MHz one. The company man said no because the 90-MHz chip and even the 60-MHz devices were similarly flawed.

How will you be able to learn if your Pentium computer is flawed? I hear that there are more than 100 combinations that can result in an erroneous reading. Some diagnostic programs are already on the market to check this out. Data Depot (tel.: 813-446- 3402) announced one. An easy way to tell if your Pentium chip has the bug, says Aaron Meyerowitz, an associate professor of math at Florida Atlantic University, Boca Raton, FL, is to perform a simple calculation on Microsoft *Windows'* calculator, as follows: Divide 4,195,835 by 3,145,727 and multiply the result by 3,145,727. You should get 4,195,835. A flawed Pentium will show an incorrect value of 4,195,579. A 486, 386 or SX version with math coprocessor will display the correct value, by the way. Another revealing combination is 5,505,001 divided by 294,911 and then multiplied by 294,911. The result should be 5,505,001. A defective Pentium computer shows 5,504,809.

For most users, this is no big deal. For a very few, it certainly is.

My advice to a prospective buyer, before the dust settled down, was to buy the Pentium machine anyway. This was based on two facts: (1) The user's applications wouldn't likely call into play the problem since he wasn't involved in heavy-duty floating-point calculations. (2) An Intel spokesperson (tel.: 1-800-628-8686) had assured me that Intel would replace the flawed Pentium with an error-free one for the life of the machine purchased should any application utilized require it. The company would put this in writing, he said.

The person who sought my advice ignored my sage counsel and canceled his order. Having a change of heart next day, he phoned to reinstate the order and learned that he'd have to wait an extra two weeks for deliv-

(Continued on page 108)

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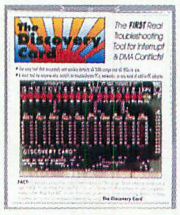

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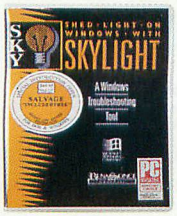

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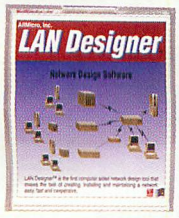

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IBM previously announced plans to provide electronic software shopping, ordering and delivery service to customers worldwide through a high-speed networking service. Since March, the system has been in a pilot program at Sears, Roebuck & Co. The company is also exploring software delivery through such public on-line services as Prodigy, over the Internet and through digital satellites.

A USER-FRIENDLY VIRUS. Absolute Software introduced a transparent sentinel program that hides a "good" virus on the hard drive to help recover a stolen computer. At regular intervals, the sentinel uses the computer's modem to call in to a dedicated toll-free CompuTrace Theft Retrieval System line on a regular basis. The call doesn't interfere with any computer operations. Moreover, anti-virus programs are said to ignore the sentinel. To subscribe, call 800-220-0733. When you do, the sentinel will be downloaded to your hard disk or Flash ROM. Cost is $49.95 per year. The company states that it will pay the insurance deductible up to $200 if the stolen computer isn't recovered within four months. For more information, call 604-730-9851.

MUSIC...MUSIC. A new version of ConcertWare, Version 1.5 for Windows and Macintosh, was announced by Jump!Software (tel.: 415-917-7490). The $159 music composition and arrangement program lets musicians quickly record music using an on-screen piano keyboard or any MIDI instrument. Music is then displayed on-screen in standard notation, which can be edited and then printed as sheet music in a complete score or individual parts. For Windows, a 386 or better processor, 2M of available RAM and a Windows-compatible sound card or MIDI sound module are required.

PENTIUM FEVER. For a brief period, Intel's Pentium microprocessor's flaw rivaled the O.J. Simpson case in media coverage. Since most users concluded that there's no need to worry, sales of Pentium machines remained strong and Intel's stock, which initially dipped when the flaw was publicized, rebounded. The problem was caused by leaving out five of 4,000 look up-table numbers, which are used to check accuracy of an algorithm's results. If any two numbers are related to the missing table numbers in a division problem, an error is produced. By this time, most Pentium machines on the market should be clean. Intel is providing free local installation service of unflawed Pentium chips. You carry the CPU unit in, of course.

IN-HOUSE DEVELOPMENT CODES. Just as the military uses code names for invasions, the computer industry does the same for its secret development work. Interestingly, Apple Computer used Carl Sagan's name as an in-house code for a computer it was working on. The famous astronomer sued Apple for invasion of privacy, but the Court ruled against him. The company then changed its code name for the Power Macintosh 7100-66 to "Butt-Head Astronomer." The Court ruled that Sagan was not libeled with the new name.

UPS SLIDE CHART. Tripp Lite offers a free "UPS Selector" slide chart to guide users through the task of choosing a UPS. The user simply lines up an arrow at chosen power and backup-time requirements for equipment to be protected by an uninterruptible power supply, reading the appropriate Tripp Lite model at the bottom of the chart. For a personal copy of the chart, call 312-329-1601.

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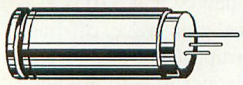

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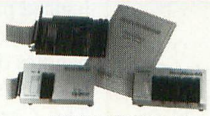

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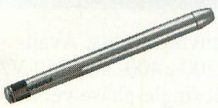

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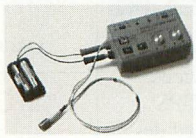

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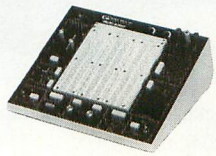

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Laser Diodes

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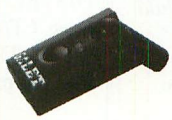
LS9321	Toshiba	650nm	5 mW	99.99	94.99	85.49
LS9200	Toshiba	670nm	3 mW	29.99	28.49	25.64
LS9211	Toshiba	670nm	5 mW	39.99	37.99	34.19
LS9215	Toshiba	670nm	10 mW	79.99	75.99	68.39
LS9140	Toshiba	685nm	20 mW	169.99	161.49	145.34
LS022	Sharp	780nm	5 mW	17.99	17.09	15.38
SB1053	Phillips	820nm	10 mW	10.99	10.44	9.40

Laser Pointer



- Swivel head
- 670nm
- > 4 mW output
- Weighs less than 2.5 oz.
- Size approx. 4" L x 2" W x 0.75" D
- Dual mode - continuous/blink
- Visible up to 150 ft.
- Runs on 2 AAA batteries

Stock#	1-9	10-24	25+
GALET	59.99	56.99	51.29

Robotic Arm Kit

Fascinating and educational, with lift/lower, grab/release, and pivot left/right functions. Uses 2 C batteries (not inc.); approx. 10" long. Use Y01IBM interface to program from your PC!

Stock#	1-9	10-24	25+
Y01	43.99	41.79	37.61
Y01IBM	35.99	34.19	30.77

Scoot Car Kit

- Movement - 4 wheels driven by 1 DC motor
- Control - air propelled, direct motor drive, or solar battery (sold separately)
- Power source 2 - D or 2 - AA batteries
- Color - blue, yellow, black

Stock#	1-9	10-24	25+
OWI655	14.99	14.24	12.82

Computer Care Kit

A complete computer care kit. Contains cleaning diskette, head-cleaning fluid, cleaning swabs, anti-static cleaner, anti-static screen wipes. SB1099 for 3.5" drives, SB1100 for 5.25" drives.

Stock#	1-9	10-24	25+
SB1099	2.99	2.84	2.56
SB1100	2.99	2.84	2.56

Adjustable Lens Assembly

- Adjustable 3 element glass AR coated lens
- Brass barrel acts as heat sink
- Adjustable at 40 TPI
- Fits all 9 mm laser diodes

Stock#	1-9	10-24	25+
LSADJ	39.99	37.99	34.19

Telephone Kit

Build this high-tech, see-thru plastic telephone. Learn theory on how telephones work. Flashing neon lamps when phone rings. Redial system and wall mount included. Comes complete with manual

Stock#	1-9	10-24	25+
PT223K	15.99	15.19	13.67

- Order Line — (800) 824-3432 • International Orders — (818) 341-8833 • Fax Orders — (818) 998-7975
- Technical Support — (818) 341-8833 • No Minimum Order – Orders under $15.00 subject to $ 5.00 service charge
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Unicorn Electronics
10000 Canoga Avenue, Unit C-2
Chatsworth, CA 91311

CIRCLE NO. 105 ON FREE INFORMATION CARD

Hardware

Laptop Workcenter

Brookstone's Portable Laptop Workcenter carrying case eliminates the need to remove a notebook computer from its case to work with it. When open, the Workcenter reveals a complete desktop environment. Support arms connect to the base of the computer, and an exclusive internal wiring management system routes peripheral cords from a storage

pocket directly to the laptop ports.

Other special features include a pouch for extra peripherals and additional pockets that can be used for PCMCIA cards, pens, airline tickets, floppy disks and other items. $139. *Brookstone Co., Nashua, NH; tel.: 800-343-9855.*

CIRCLE NO. 1 ON FREE CARD

Ink-Jet Cartridge Cleaner

Falcon's Dust-Off Ink Jet Cartridge Cleaning System lets you restore clogged ink-jet

heads to assure continued sharp printer output. The system is said to safely and easily loosen and remove dried ink and contaminants with its patented built-in HyperBRUSH microfiber surface. $14.95. *Falcon Safety Products, Inc., 25 Chubb Way, Branchburg, NJ 08876; tel.: 908-707-4900; fax: 908-707-8855.*

CIRCLE NO. 2 ON FREE CARD

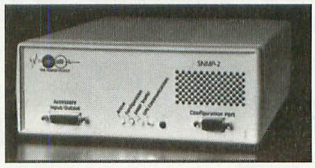
New CD ROM Drive

DISTEC's RoadRunner Express CD-4X external quad-speed CD-ROM drive plugs into the parallel port of a PC and supports both the EPP (enhanced parallel port) and ECP (extended capabilities port). It handles data-transfer rates up to 600K/second. $499. *DISCTEC Corp., 925 S. Semoran Blvd., Ste. 114, Winter Park, FL 32792; tel.: 800-553-0337; fax: 407-671-6606.*

CIRCLE NO. 4 ON FREE CARD

SNMP Manageable UPS Adapter

The Tripp Lite SNMP-2 Adapter lets you remotely monitor ac power conditions across a



network or control power to individual network devices. With this adapter, the UPS now becomes a managed device sitting directly on the network. $799. *Tripp Lite, 500 N. Orleans, Chicago, IL 60610; tel.: 312-329-1777; fax: 312-644-6505.*

CIRCLE NO. 5 ON FREE CARD

PCI/SCSI-2 Controller

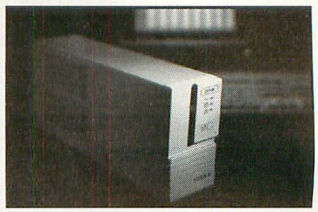
New from Future Domain, the TMC-3260 is a PCI/SCSI-2 local-bus controller that fully complies with the new PCI 2.0

specification. It's fully autoconfiguring, eliminating the need for you to perform either jumper or software settings. The TMC-3260 is based on the Future Domain 36C70 single-chip 32-bit PCI local-bus-to-SCSI-2 integrated circuit. $139. *Future Domain, Corp., 2801 McGaw Ave., Irvine, CA 92714; tel.: 714-253-0400; fax: 714-253-0913.*

CIRCLE NO. 6 ON FREE CARD

New UPS

Sola's new SOLA 310 is a modified-sine-wave, off-line uninterruptible power system that operates in both 50- and

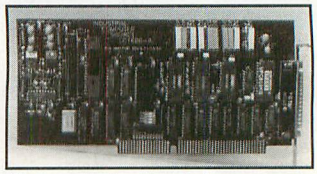


60-Hz environments. Available in 300-, 400- and 750-VA 120-volt single-phase versions, it's equipped with a cold-start feature that permits smooth UPS start-up without ac input or generator power. $169/$239/$469, 300/400/750. *SOLA, 1717 Busse Rd., Elk Grove Village, IL 60007; tel.: 800-289-7652; fax: 800-626-6269.*

CIRCLE NO. 7 ON FREE CARD

Data-Acquisition Card

The Model LC1600-P multifunction analog and digital I/O card from Industrial Computer



Source is designed for general-purpose data-acquisition and control applications. It comes with an installation routine and sample source code to get you started.

Analog features include 16 single-ended or eight differential channels with 12 bits of resolution and a 35-µs maximum conversion rate; programmable gains of 1, 10, 100 and 1,000; and two 12-bit analog output channels. On the digital side are four each input and output lines and 24 bi-directional lines from an 8255 PPI logic controller. An 8254 counter/timer provides three 16-bit down counters. $399. *Industrial Computer Source, 9950 Barnes Canyon Rd., San Diego, CA 92121; tel.: 800-523-2320; fax: 619-677-0895.*

CIRCLE NO. 8 ON FREE CARD

30-Bit Scanner

The RELI4830 PC/TE from Relisys is a 30-bit 400 X 1,600-dpi flatbed scanner that recognizes more than 1-billion colors. The scanner employs ColdScan technology, a process that uses cold-cathode lamps to capture color images. As a result, the scanner requires no cooling fan, and provides dust-free scanning that, according to the company, means there's no need to touch up images. Also, with ColdScan, the scanner uses less energy, has increased lamp life and reliability and needs no warm-up time.

The Reli4830 PC/TE includes a transparency adapter in the lid for producing negatives, slides and transparencies. Bundled with the scanner are *PhotoShop* full-version, *OmniPage Direct*, *Art-Scan Professional* and *Kai's Power Tools*. $1,699. *Relisys, 919 Hanson Ct., Milpitas, CA 95035; tel.: 408-945-3113; fax: 408-945-1499.*

CIRCLE NO. 3 ON FREE CARD

Parallel-Port Keyboards

Genovation's Parallel Keyboard 101 full-size, 101-key keyboard for notebooks and subnotebooks connects to any PC/compatible notebook computer via the printer port. Utilizing a T connector, both a printer and the keyboard can be connected to the same printer port and be used simultaneously. Power consumption is less than 1 mA.

Optional software lets you program each key with macros, each up to 64 characters in length. $115. *Genovation, Inc., 17741 Mitchell, North Irvine, CA 92714; tel.: 714-833-3355; fax: 714-833-0322.*

CIRCLE NO. 9 ON FREE CARD

Alps Electric's ALPS LPT-101 parallel port keyboard and ALPS KPX-17P parallel port numeric keypad plug directly into the parallel port of any notebook, laptop or portable computer. The ALPS KPX-17S numeric keypad plugs into the serial port. Parallel-port products come equipped with a pass-through connector cable to support other peripherals, such as a printer.

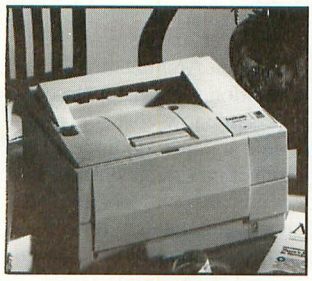
The LPT-101 features audible key clicks and low power consumption. Its conductive rubber membrane technology provides a firm tactile feel, while protecting against spills and dust. $109/$95/$95. LPT-101/KPX-17P/KPX-17X. *Alps Electric, Inc., 3553 N. First St., San Jose, CA 95134; tel.: 408-432-6000; fax: 408-432-6035.*

CIRCLE NO. 10 ON FREE CARD

Windows Printers

Lexmark's WinWriter 100, 200 and 400 are designed specifically for Microsoft *Windows* users. WinWriter 100 is a compact ink-jet model that prints up to 3 ppm and uses Print Quality Enhancement Technology that lets it achieve 600 x 300 dpi output. WinWriter 200 is a 300-dpi laser unit that prints at 4 ppm and includes 512K of memory and 22 *TrueType* fonts. WinWriter 400 is a 600-dpi LED page model that prints at 5 ppm and includes 2M of memory, 44 *TrueType* fonts and a 150-sheet input/output capacity.

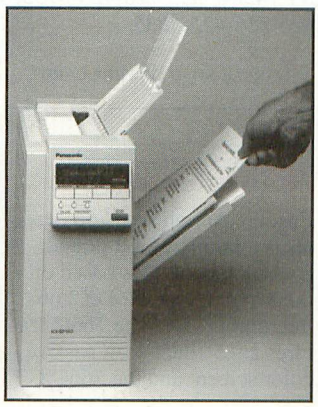
All models include Microsoft *At Work* printing software for optimal *Windows* printing performance and are claimed to be compatible with current and future versions of the Microsoft *Windows* operating system. $349/$579/$899, 100/200/400. *Lexmark Int'l., Inc., 740 New Circle Rd. NW, Lexington, KY 40511; tel.: 800-358-5835.*



CIRCLE NO. 11 ON FREE CARD

Printer/Fax/Copier

Panasonic's KX-SP100 combination printer, fax and copier is a 300-dpi laser printer that features a 4-ppm engine, 2M of RAM, 70-page input tray and HP PCL4 emulation. The fax portion is a Group 3 plain-paper fax machine with a 10-page automatic document



CIRCLE NO. 83 ON FREE INFORMATION CARD

feeder, automatic reduction mode and a journal print function that lists the last 35 transmissions and/or receptions. The copier portion is a plain-paper unit that copies the first page at a rate of 1.5 ppm and subsequent pages at 4 ppm and accepts originals of up to 10 pages in length.

The KX-SP100 accepts an incoming fax up to 18 pages in length while the printer is in operation and stores it in memory for later retrieval. $999. *Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; tel.: 201-348-7000.*

CIRCLE NO. 12 ON FREE CARD

New Notebooks

Canon Computer Systems' Innova Book 150C and 150CT are 486DX2-based notebook computers that have built in digital audio and enhanced graphics capabilities. The dual-scan color 150C and active-matrix color 150CT feature a 50- or 66-MHz CPU, 32-bit local-bus video with *Windows* accelerator, 250M or 340M hard disk, 4M of RAM, floppy drive and two PCMCIA Type II (or one Type III) slots. The 3½" drive can be removed and replaced with a second NiMH battery.

Innova Book has full digital sound with record, compress, store and playback of voice, sound and music, using a built-in microphone/speaker; line-in/line-out functions; and external microphone jacks. $2,399, 150C Model IB250/50. *Canon Computer Systems, Inc., 2995 Redhill Ave., Costa Mesa, CA 92626; tel.: 714-438-3000; fax: 714-438-3099.*

CIRCLE NO. 13 ON FREE CARD

AC-Power Center

Pow-R-Bar from International Micro Electronics Group is an intelligent, configurable, six-outlet ac power center. When

connected to the serial port of a computer, each of the unit's six 117-volt ac outlets on the rear panel of the Pow-R-Bar is controllable through simple commands. *Windows* and DOS demonstration programs, which can operate one or up to 26 Pow-R-Bars daisy-chained together, are included. Pow-R-Bar is rated for 117-volt, 60-Hz ac operation, with a total capacity of 10 amperes. $149.95. *International Micro Electronics Group, Ltd., 155 W. Tiverton Way, Lexington, KY 40503; tel.: 800-274-8699; fax: 606-245-1798.*

CIRCLE NO. 14 ON FREE CARD

New Pointing Device

Alps Electric's GlidePoint touch surface pointing device for IBM PS/2 and compatible computers offers compact size (2.5" x 1.9"), 400-dpi resolution, DOS and *Windows* compatibility and the ability to work with standard mouse drivers (an optimized driver is included). Tapping a finger lightly on the GlidePoint surface is just like clicking a mouse, though three buttons are available, too. With solid-state construction and virtually no

moving parts, except for the buttons, there's very little wear, and contamination from dirt is virtually eliminated. $96. *Alps Electric, 3553 N. First St., San Jose, CA 95134; tel.: 408-432-6000; fax: 408-432-6035.*

CIRCLE NO. 15 ON FREE CARD

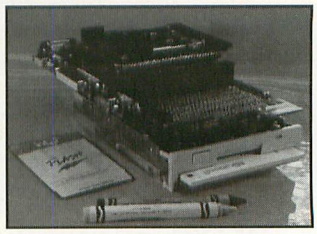
VGA-to-Video Converter

The Model 704 Super Deluxe Videoverter from Telebyte Technology converts VGA images to NTSC or PAL TV formats. It's equipped with outputs for S-VHS, AV and r-f, all of which are available simultaneously. Videoverter operates under control of a DOS TSR software driver. It supports VGA modes up to 640 x 480 at up to 64K colors. $545. *Telebyte Technology, Inc., 270 Pulaski Rd., Greenlawn, NY 11740; tel.: 516-423-3232; fax: 516-385-8184.*

CIRCLE NO. 16 ON FREE CARD

Compact PC

GCAT-DEV is a compact PC-plus-disk drive combination from Saelig that can boot from MS-DOS in ROM or on disk.



Built around the Chips & Technologies 14-MHz JF8680 PC/Chip, GCAT-DEV features on-board connectors for LCD or CRT display, keyboard, mouse, printer, two serial ports and a PCMCIA card. Also included are an on-board speaker, calendar clock, negative voltage generator for LCD screens, 1M of RAM and a six-channel 12-bit-plus-sign A/D converter with 10-s conversion time. $999. *The Saelig Co., 1193 Moseley Rd., Victor, NY 14564; tel.: 716-425-3753; fax: 716-425-3835.*

CIRCLE NO. 17 ON FREE CARD

DX2-66 Notebooks

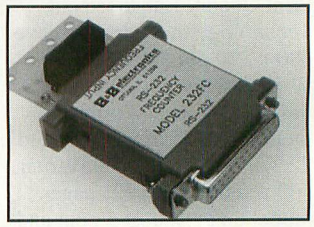
Epson's ActionNote 766 Series is a family of 4.9-pound, color notebook PCs based on the 3-volt Cyrix 486DX2/66 microprocessor. The 766C features a 9.5" dual-scan passive color screen, and the 766CX features and 8.5" TFT active-matrix color display. Both models support local-bus video, standard VGA modes and external color VGA displays.

Each model comes with 8M of RAM, a choice of 260M or 340M removable hard drive and integrated power-management features. Other features include an NiMH power supply, built in 14.4K modem, PCMCIA Type II slot, 3½" floppy drive and two-button trackball. $2,999/$3,499, 766C (260M)/766CX (340M). *Epson America, Inc., 20770 Madrona Ave., Torrance, CA 90503; tel.: 310-782-0770.*

CIRCLE NO. 18 ON FREE CARD

RS-232 Frequency Counter

B&B Electronics' Model 232-FC RS-232 frequency counter makes frequency measurements of TTL-level signals. It makes frequency measurements from 5 Hz to 2 MHz and duty cycle measurements from 5 Hz to 50 kHz. The 232-FC comes with software that logs and plots frequency and duty-cycle information and displays histograms. $69.95.



B&B Electronics Manufacturing Co., 707 Daytona Rd., PO Box 1040; Ottawa, IL 61350; tel.: 815- 434-0846; fax: 815-434-7094.

CIRCLE NO. 19 ON FREE CARD

Signal Conditioner

The Open Architecture Signal Conditioner Kit from Dascor is a versatile low-cost configurable signal conditioner. The product mix ranges from bare circuit cards with complete design documentation for roll-your-own applications through

Bar-Code Products

SCAN-ONE for PCMCIA is a complete bar-coding solution from Vertical Technologies that includes a

Type II PCMCIA card and cable, SCAN-ONE wand, connector and software. You simply plug the PCMCIA card into a computer's PCMCIA slot, plug the bar-code input device into the PCMCIA card, load the software driver, set the options and start scanning. *Vertical Technologies, 11170 South State, 2nd. Fl., Sandy, UT 84070; tel.: 801-576-9700; fax: 801-576-5538.*

CIRCLE NO. 20 ON FREE CARD

ComputerWISE's WISEwand 1 bar-code scanning wand features integral decoding and an RS-232 serial interface for ASCII data output and power input. The ultra-low power consumption of WISEwand lets it operate on the voltage available from the serial port to which it's connected. WISEwand is claimed to decode most of the common bar-code symbologies. $299.

ComputerWISE, 302 N. Winches- ter, Olathe, KS 66062; tel.: 913-829-0600; fax: 913-829-0810.

CIRCLE NO. 21 ON FREE CARD

complete integrated turnkey systems to meet custom and OEM requirements. A starter kit includes one board and documentation. $50. *Dascor, PO Box 1447, Solana Beach, CA 92075; tel.: 619-792-7788; fax: 619-259-6772.*

CIRCLE NO. 22 ON FREE CARD

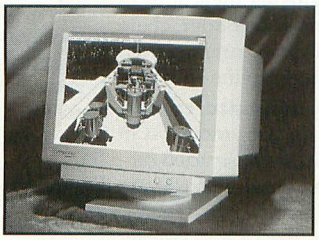
Wavetable Upgrade Board

Ensoniq's Soundscape Daughter Board is said to be capable of upgrading any 16-bit FM card with a 26-pin audio expansion connector to wavetable sound. It features 16 channels, 31 simultaneous voices and 32-note polyphony; 1M E-wave patch set and onboard Motorola 68EC000. Bundled software includes music MIDI files. $129. *Ensoniq, 155 Great Valley Parkway, Malvern, PA 19355; tel.: 610-647-3930; fax: 610-647-8908.*

CIRCLE NO. 23 ON FREE CARD

Color-Matching Video Monitor

The Optiquest 4000TC 17" Trinitron color monitor features color-matching control, energy saving capability and an auto-



sensing power supply. It offers a resolution of 1,280 x 1,024 with a noninterlaced refresh rate of 60 Hz and maximum rate of 76 Hz. Overscan capability uses the entire screen for edge-to-edge display, and microprocessor control offers 15 programmable modes. $849. *Optiquest, Inc., 20490 East Business Pkwy., Walnut, CA 91789; tel.: 909-468-3750.*

CIRCLE NO. 24 ON FREE CARD

(Continued on page 113)

TECHNOLOGY UPDATE

900 MHz breakthrough!

New technology launches wireless speaker revolution...

Recoton develops breakthrough technology which transmits stereo sound through walls, ceilings and floors up to 150 feet.

Breakthrough wireless speaker design blankets your home with music.

By Charles Anton

If you had to name just one new product "the most innovative of the year," what would you choose? Well, at the recent *International Consumer Electronics Show*, critics gave Recoton's new wireless stereo speaker system the *Design and Engineering Award* for being the "most innovative and outstanding new product."

Recoton was able to introduce this whole new generation of powerful wireless speakers due to the advent of 900 MHz technology. This newly approved breakthrough enables Recoton's wireless speakers to rival the sound of expensive wired speakers.

Recently approved technology. In June of 1989, the *Federal Communications Commission* allocated a band of radio frequencies stretching from 902 to 928 MHz for wireless, in-home product applications. Recoton, one of the world's leading wireless speaker manufacturers, took advantage of the FCC ruling by creating and introducing a new speaker system that utilizes the recently approved frequency band to transmit clearer, stronger stereo signals throughout your home.

Crisp sound throughout your home. Just imagine being able to listen to your stereo, TV, VCR or CD player in any room of your home without having to run miles of speaker wire. Plus, you'll never have to worry about range because the new 900 MHz technology allows stereo signals to travel over distances of 150 feet or more through walls, ceilings and floors without losing sound quality.

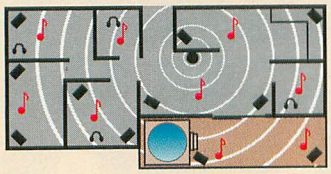
One transmitter, unlimited receivers. The powerful transmitter plugs into a headphone, audio-out or tape-out jack on your stereo or TV component, transmitting music wirelessly to your speakers or headphones. The speakers plug into an outlet. The one transmitter can broadcast to an unlimited number of stereo speakers and headphones. And since each speaker contains its own built in receiver/amplifier, there are no wires running from the stereo to the speakers.

Full dynamic range. The speaker, mounted in a bookshelf-sized acoustically constructed cabinet, provides a two-way bass reflex design for individual bass boost control. Full dynamic range is achieved by the use of a 2" tweeter and 4" woofer. Plus, automatic digital lock-in tuning guarantees optimum reception and eliminates drift. The new technology provides static-free, interference-free sound in virtually any environment. These speakers are also self-amplified; they can't be blown out no matter what your stereo's wattage.

150 foot range through walls!

Recoton gives you the freedom to listen to music wherever you want. Your music is no longer limited to the room your stereo is in. With the wireless headphones you can listen to your TV, stereo or CD player while you move freely between rooms, exercise or do other activities. And unlike infrared headphones, you don't have to be in a line-of-sight with the transmitter, giving you a full 150 foot range.

The headphones and speakers have their own built-in receiver, so no wires are needed between you and your stereo. One transmitter operates an unlimited number of speakers and headphones.



Recoton's transmitter sends music through walls to wireless speakers over a 75,000 square foot area.

Stereo or hi-fi, you decide. These speakers have the option of either stereo or hi-fi sound. You can use two speakers, one set on right channel and the other on left, for full stereo separation. Or, if you just want an extra speaker in another room, set it on mono and listen to both channels on one speaker. Mono combines both left and right channels for hi-fi sound. This option lets you put a pair of speakers in the den and get full stereo separation or put one speaker in the kitchen and get complete hi-fi sound.

These wireless stereo headphones have a built-in receiver.

Factory direct savings. Our commitment to quality and factory direct pricing allows us to sell more wireless speakers than anyone! For this reason, you can get these speakers far below retail with our 30 day *"Dare to Compare"* money-back guarantee and full one year manufacturer's warranty. For a limited time, the Recoton transmitter is only $69. It will operate an unlimited number of wireless speakers priced at $89 and wireless headphones at $59 each. Your order will be processed in 72 hours and shipped UPS.

Recoton Transmitter (you must have a transmitter to operate speakers and headphones).....**$69** $4 S&H

Wireless products compatible with the Recoton transmitter:

Recoton Wireless Speaker.....**$89** $6 S&H

Recoton Wireless Headphones.....**$59** $4 S&H

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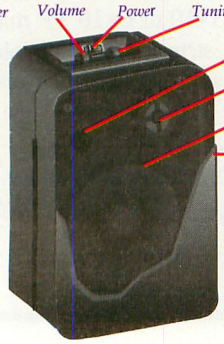
COMTRAD INDUSTRIES

2820 Waterford Lake Drive Suite 106
Midlothian, Virginia 23113

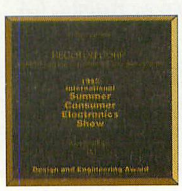
AWARD WINNING WIRELESS SPEAKER

Built-in receiver and amplifier: *The wireless speaker and headphones both contain a built-in receiver and amplifier. Signals are picked up and transmitted as far as 150 feet away through walls without the use of wires.*



Size: 9"H x 6"W x 5.5"L
Signal-to-noise ratio: 60 dB
Channel Separation: 30 dB
Two-way bass reflex design
10 watts/channel RMS amps
Frequency Response: 50 Hz-15 KHz

Don't take our word for it. Try it yourself. We're so sure you'll love the new award-winning Recoton wireless speaker system that we offer you the **Dare to Compare Speaker Challenge.** Compare Recoton's rich sound quality to that of any $200 wired speaker. If you're not completely convinced that these wireless speakers offer the same outstanding sound quality as wired speakers, simply return them within 30 days for a full "No Questions Asked" refund.



Recoton's Design and Engineering Award

By Wallace Blackburn

Getting Started With the MC68HC705K1 Microcontroller

Use this low-cost MCU to get started in experimenting with microcontrollers, using free software and a tiny programmer you can build

A versatile little controller from Motorola, the MC68HC705K1, should be especially interesting to anyone who wishes to get started in experimenting with microcontrollers. It features a simple but powerful design, and it's easy to program without the need for expensive equipment. In fact, I'll show you how to build a programmer for less than $40, which should eliminate the high start-up cost one usually experiences when getting started with any controller. First, however, let's look at what this controller does and how to use it.

About the Controller

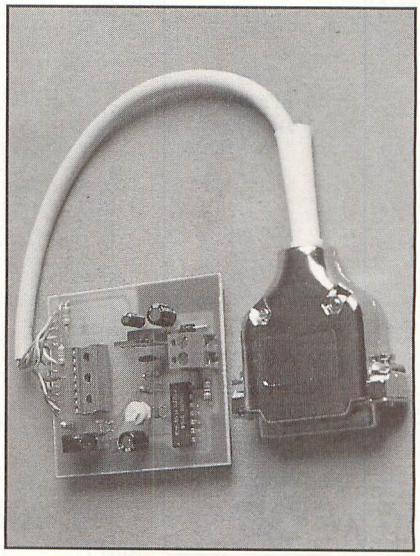
The tiny 'K1 microcontroller is similar to the PIC devices from Microchip Technology. It's a member of the very-popular M68HC05 family from Motorola. These eight-bit microcontroller units (MCUs) all have at their cores the M68HC05 CPU. They're available in a wide variety of forms, with different memory sizes, packaging and subsystems.

Included in the 'K1 are 504 bytes of EPROM, 32 bytes of RAM, 10 bidirectional I/O pins and a 15-bit multifunction timer. This MCU also has a single dedicated interrupt line and interrupt capabilities on four I/O pins. An on-chip oscillator permits use of a crystal, ceramic resonator or even an RC circuit for clock timing. A Computer Operating Properly (COP) watchdog timer, which can be disabled or enabled at your discretion, is provided to automatically reset the MCU if it isn't cleared periodically by an instruction sequence.

The 'K1 is available in a 16-pin plastic DIP as the MC68HC705K1P, 16-pin SOIC as the MC68HC705-K1DW and 16-pin ceramic DIP as the MC68HC705K1S. The plastic DIP and SOIC packages have no window for EPROM erasing. Therefore, their EPROMs function as one-time programmable ROMs (OTPROMs). By using the inexpensive plastic package, these OTPROMs are economical, even for low-volume applications. The 16-pin DIP version is available for less than $6 in small quantities.

For complete details on the 'K1, order the free data book from Motorola, Document No. MC68HC705K1/D. Another excellent book available from Motorola is *Understanding Small Microcontrollers* by James Sibigtroth, which goes for $31.30 in single quantity (discounts are available for quantity orders). If you're a student, you can purchase this book for $25.50. (You can reach Motorola Literature by dialing 800-441-2447.) This book introduces small microcontrollers using the 'K1 as an example. I can't recommend it highly enough.

The 'K1's 10 I/O lines are organized into Port A with eight bits and Port B with two bits and are designated as PA0 through PA7 and PB0 and PB1. They're true bidirectional pins and are selectable as input or output from software. Each pin can be configured independently via its corresponding Data Direction Register. Each bit in these registers sets the direction for the corresponding bit in the appropriate port. A 0 causes the bit to be an input, a 1 an output. Each pin also has an internal pull-down transistor that can be set in a similar manner, using the Pull-down Register for the port. A pin can source a maximum current of 25 mA.



Internal to the 'K1 are 496 bytes of user EPROM from 0x0200 through 0x03EF. User RAM runs from 0x00E0 through 0x00FF. The stack also uses this RAM "from the bottom up." In other words, the stack grows upward from 0x00FF. For this reason, you should put temporary data at the beginning of the RAM area and use no more than necessary to prevent the stack and your data from colliding with each other. The memory map for the 'K1 is shown in Fig. 1.

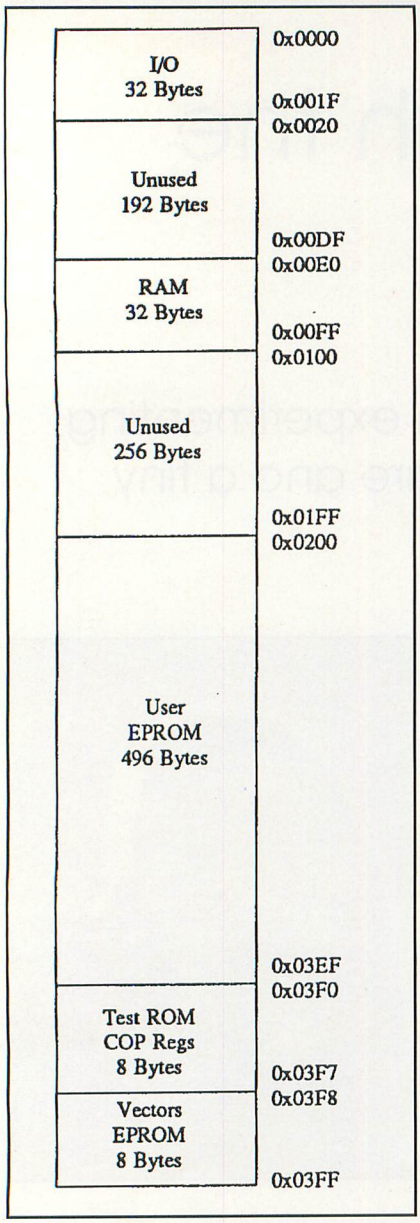


Fig. 1. This is the memory map for the MC68HC705K1 microcontroller.

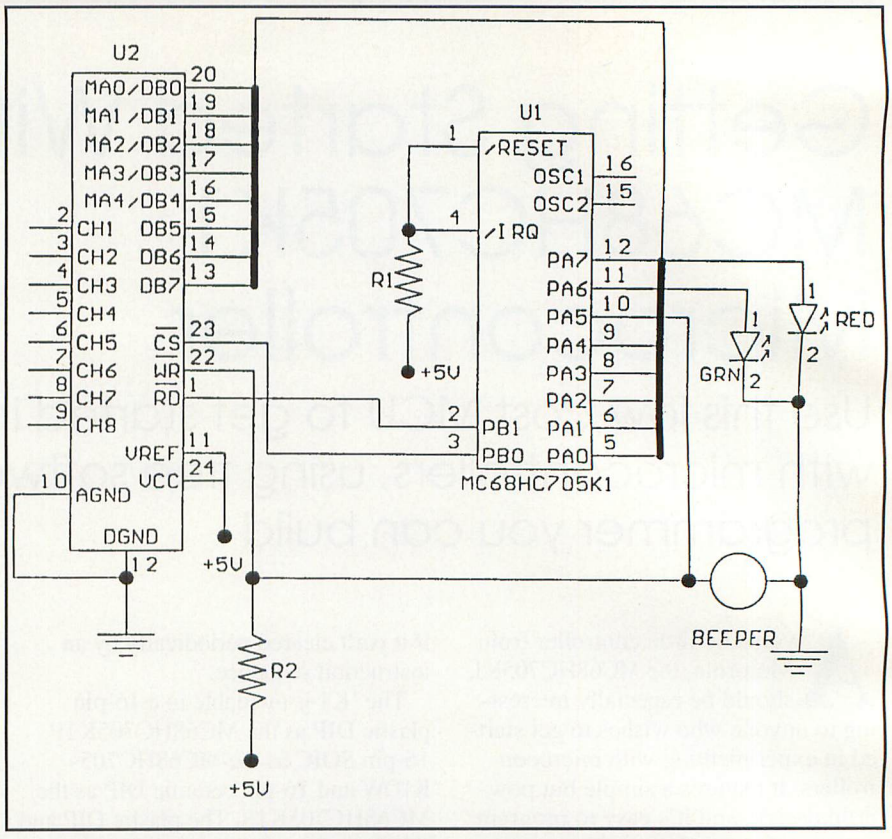


Fig. 2. You can pair the 'K1 with an ADC0848 eight-channel A/D converter to check up to eight physical parameters and provide good/bad indications based on the results of the measurements.

Being an HCMOS device, the 'K1 can operate with either a 3.3- or 5-volt power supply. It also has a data-retention mode in which the supply potential can be as low as 2 volts. It also has power-saving, or "sleep," modes that permit the MCU to consume a minuscule amount of power until an event like an interrupt or timer overflow wakes it up. In STOP mode with a 3.3-volt supply, the 'K1 draws only 50 nA! With power consumption this low, a power switch isn't even needed. This can simplify design for remote battery-powered applications.

Another feature of HCMOS devices is fully static operation,with no minimum clock speed. Maximum clock speed is rated at 2 MHz, provided by a 4-MHz crystal or resonator (the internal clock speed is half that of the oscillator).

The 'K1 uses the popular 6805 instruction set. While there isn't sufficient space for the entire instruction set, it does provide a full complement of bit-manipulation instructions and an unsigned 8x8 multiply. Also included on the 'K1 are a wide variety of addressing modes.

A well-rounded set of interrupts is available on the 'K1. One pin on the chip is dedicated to an external interrupt. Additionally, I/O pins PA0 through PA3 can serve as additional interrupt sources, with proper software configuration. These external interrupts can be either edge- or level-triggered. Other interrupts include a software interrupt, a timer overflow interrupt and a real-time interrupt using the timer.

Five different resets are possible with the 'K1. These include power-on reset, external reset using the RESET pin, COP reset, illegal address reset and low-voltage reset. The last is used to reset the MCU when the supply's output drops to less than 3.5 volts. Both low-voltage and COP resets can be enabled or disabled at your option. Obviously, low-voltage reset would be used only in a 5-volt system.

Typical Applications

At such low prices, the 'K1 can economically replace even a few discrete logic chips in many applications. Recently, a friend wanted to develop a circuit to sequentially light 10 LEDs to form a "light-chaser" display. While this could have been done for a few dollars and three or four logic chips, it was easier using the 'K1. The 10 I/O pins on the 'K1 were used to drive the LEDs directly, and the software was trivial. The software was written, assembled and burnt into an OTPROM chip in less than an hour. While this is kind of like swatting a fly with a sledgehammer, it was still a less expensive than using discrete

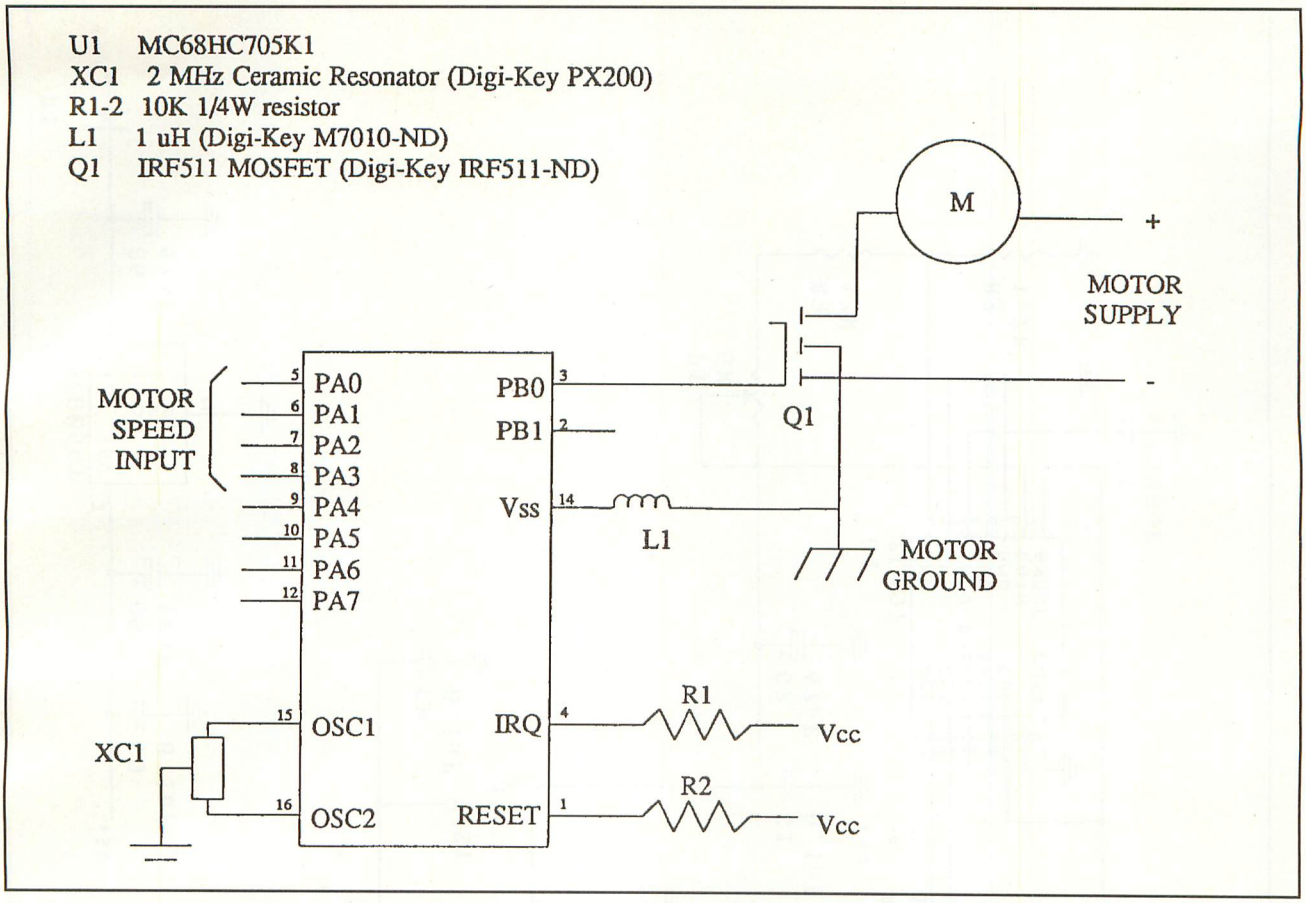


Fig. 3. In this PWM controller schematic note that the gate of MOSFET *Q1* is connected to PB0 such that when it's turned on by +5 volts from PB0, it turns on the motor winding by providing the ground path required to complete the circuit.

logic chips would have been because of the simpler physical layout and lower parts count.

While the foregoing might be an almost insignificant example of an application in which the 'K1 microcontroller can be put to use, this MCU's capabilities allow it to fill the bill for more-sophisticated applications. In another design, I paired the 'K1 with a National Semiconductor ADC0848 eight-channel A/D converter to check up to eight physical parameters and provide a good/bad indication based on the result of the measurements (Fig. 2). The design was implemented on a 5/8" x 3" printed-circuit card for a limited-space application and was powered by a 6-volt N-size battery. Some of the I/O pins had to pull double duty. Another

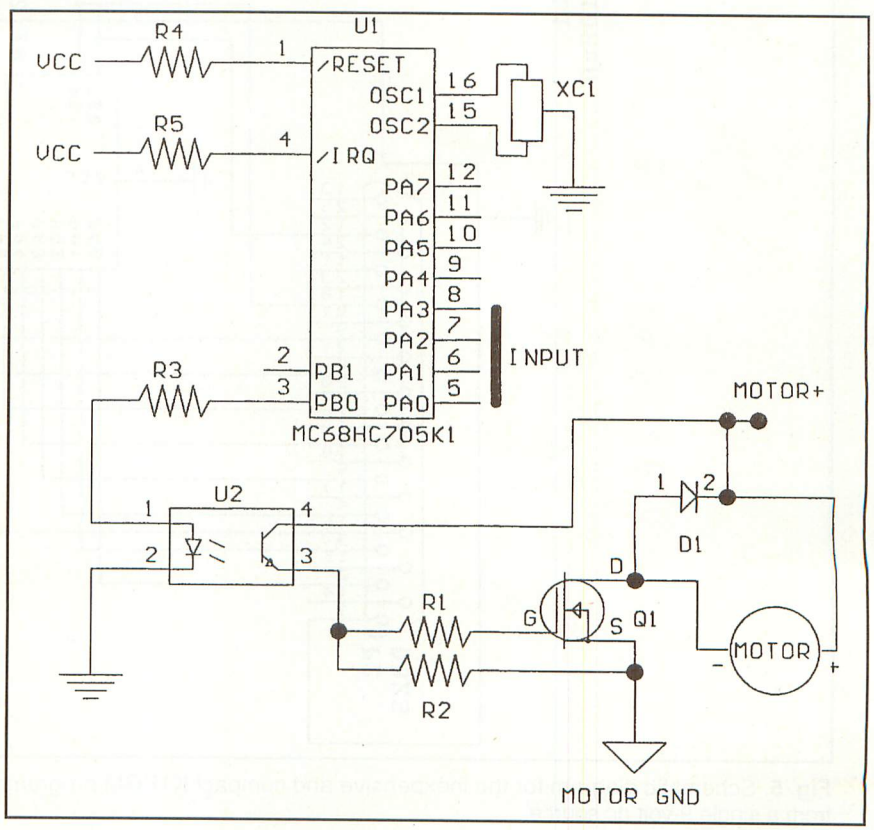


Fig. 4. To keep noise in the motor circuit, generated by the fast switching action, from entering the electronics section, you can use an optical isolator as shown here.

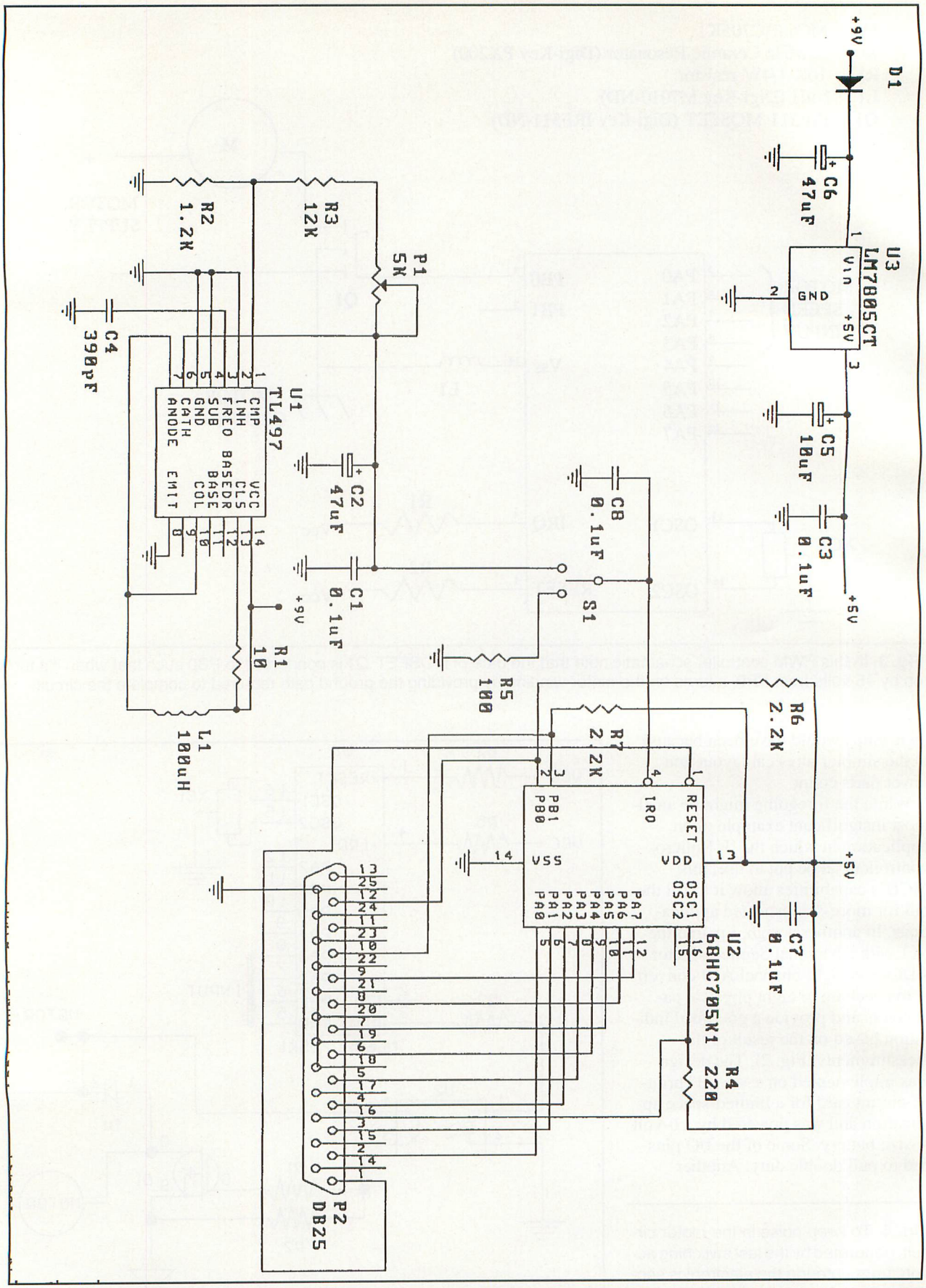


Fig. 5. Schematic diagram for the inexpensive and compact K1PGM programmer with on-board V_{pp} and V_{ss} generation from a single 9-volt dc source.

Parts Availability

The following items are available from CW Technology, 7328 Timbercreek CT, Reynoldsburg, OH 43068: K1PGM kit, including printed-circuit board, all parts (except the MC68HC705K1), sample programs and free programming software, $37; ready-to-wire pc board, $17; and MC68HC705K1S EPROM, $25. All prices include shipping. For an additional charge of $5, you can order COD shipment by calling 1-800-547-7479. Ohio residents, please add 5.5% sales tax. Sorry, no MC/Visa.

In quantity, the MC68HC705K1S/P/DW and the 68HC705KICS are available from Active Electronics at 1-800-677-8899. Single quantities of the MC68HC705K1P are available from JDR Microdevices at 1-800-538-5000.

option would be to use a serial A/D converter and "bit-bang" the input in software. Issues here would be complexity and EPROM space. As the design gets more complex, some thinking is required to get things done with only 10 I/O lines and 496 bytes of EPROM. So it's obvious that the 'K1 is no panacea. It does have limitations, as does any controller.

An on-board timer adds to the versatility of the 'K1. For example, in another application, a friend designed and implemented a controller for an amateur-radio repeater. He made use of the timer for such things as timing the periodic Morse code identification and time-out function. An obvious use for the timer would be in a pulse-width-modulation (PWM) application like a motor speed controller. With this in mind, I offer the following example application.

PWM Motor Controller

The motor speed controller application I chose to illustrate use of the 'K1 microcontroller uses a power MOSFET that's switched by one of the I/O lines to provide the PWM signal to the motor. The four lower bits of Port A (PA0 through PA3, are used as input for desired motor speed, which can be varied from full-off (0000) to full-on (1111). I use PB0 as the PWM output pin and leave PB1 and PA4 through PA7 available for other uses. Since the PWM software uses the timer interrupts, there's processing time to do other things. Alternatively, PA4 through PA7 could be used as inputs for a second PWM output on PB1.

As shown in Fig. 3, the PWM controller schematic, the gate of the MOSFET is connected to PB0. When MOSFET *Q1* is turned on by +5 volts from PB0, it turns on the motor winding by providing the ground path that completes the circuit from the V+ rail to circuit ground. The 1N4001 diodes protect the MOSFET from transients caused by turning off the power to the motor winding. Capacitors *C1* and *C2* help control noise caused by short-duration high-current demands on the power supply. Such noise can occur because of the very fast signal transitions on the 'K1's I/O lines. Inductor *L1* provides a common dc ground between the motor and logic power supplies while blocking transients. Another solution would be to use separate power supplies for the electronics and the motor and an optical isolator between the 'K1 and the MOSFET, as shown in Fig. 4.

All parts for the PWM controller are readily available and should cost no more than $10 to $15, even at retail prices. Surplus MOSFETs can be found for less than $1 each. The IRF-511 is used here, but others should work also. You can breadboard or Wire Wrap the circuit.

The code for the controller, shown in Listing 1, is simple and straightforward. The program simply loops continuously and checks the input. Other processing can be done by inserting the code in place of the busy loop. The first few lines define meaningful names for the input lines, initialize the I/O pins as inputs or outputs, etc. The reset and interrupt vectors are initialized at the end. Unused interrupts simply vector to a common point labeled UNUSED, where a return from interrupt (RTI) is performed.

'K1 Programmer

A major obstacle to most experimenters who wish to get started with microcontrollers is the usually high cost of programming equipment. This isn't

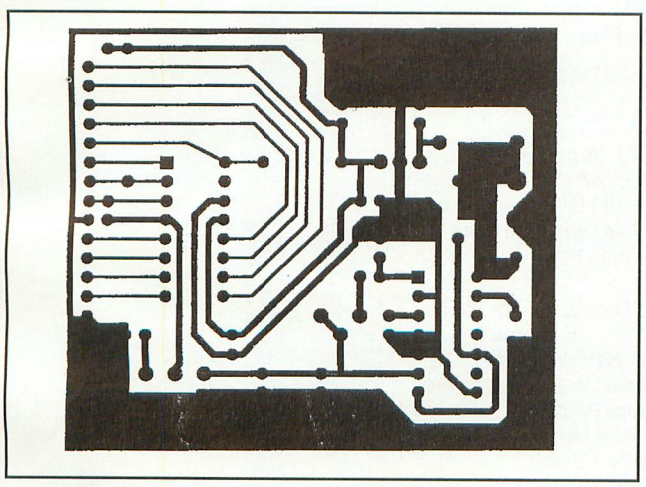


Fig. 6. Use this actual-size etching-and-drilling guide to fabricate a printed-circuit board on which to mount the components that make up the K1PGM programmer.

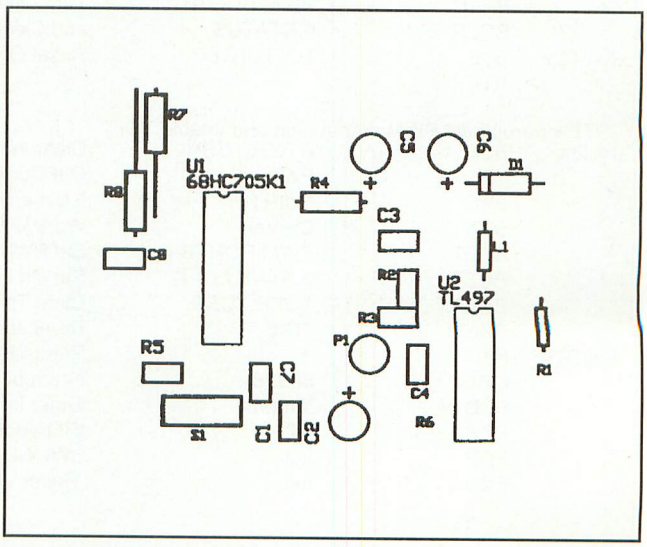


Fig. 7. This is the wiring guide for pc board.

Listing 1. Program Code for Operating K1PGM Programmer

```
PWM       EQU     0           ;PWM Output on Port B Bit 0
PORTA     EQU     $0000       ;Port A
PORTB     EQU     $0001       ;Port B
Duty100   EQU     $0F         ;100% Duty Cycle
TCSR      EQU     $08         ;Timer Counter Status Register
RT0       EQU     0           ;Real Time Interrupt Rate Select Bit 0
RT1       EQU     1           ;and 1
RTIFR     EQU     2           ;RTIF Reset
TOFR      EQU     3           ;TOF Reset
RTIE      EQU     4           ;RTI Enable
TOIE      EQU     5           ;Timer Overflow Interrupt Enable
RTIF      EQU     6           ;Real Time Interrupt Flag
TOF       EQU     7           ;Timer Overflow Flag

          ORG     $00E0       ;Start of RAM

PWMVal    RMB     1           ;PWM Duty Cycle
CurVal    RMB     1           ;Working Value for PWM
STATUS    RMB     1           ;Bit 0 is Flag for PWM On

          ORG     $0200       ;Start of ROM
Init      CLRA                ;Make All Port A's Pins Inputs
          STA     DDRA
          STA     PWMVal      ;Initially 0% Duty Cycle
          STA     STATUS      ;Clear PWM Flags
          LDA     #$03        ;Make All Port B's Pins Outputs
          STA     DDRB
          LDA     #$3C        ;Clear Timer Ints...
          STA     TCSR        ;and Enable RTIF Interrupt
          CLI                 ;Enable Interrupts

;Constantly update duty cycle from Input A
Forever   LDA     PORTA       ;Data on Port A is Duty Cycle
          AND     #$0F        ; Clear Upper 4 Bits
          STA     PWMVal      ;PWM Duty Cycle for
          BRA     Forever     ;Infinite Loop, PWM Uses Inits

;RTI Sets Period. For 1 MHz and Both RT0, Rt1 = 0, period is 16.38 ms
TimerInt  BRSET   TOF,TCSR,TOFInt   ;TOF Interrupt?
          BRSET   RTIF,TCSR,RTIInt  ;RTI Interrupt?
          RTI

;TOF Interrupt: for PWM, Check to see if it is already off, if not then decrement it when it is 0, turn off output
TOFInt    BRCLR   0,Status,ExitTOF  ;Already Off — Leave it Alone
          DEC     CurVal
          BNE     ExitTOF
          BCLR    PWM,PORTB   ;Turn Off PWM
          BCLR    0,STATUS    ;and Clear on Flag
ExitTOF   BSET    TOFR,TCSR   ;Reset Off
          RTI

;RTF interrupt: set PWM output high and enable TOF
RTIInt    BSET    RTIFR,TCSR  ;Clear the RT Interrupt Flag
          LDA     PWMVal      ;Get Current PWM Value
          BEQ     ExitRTI     ;If 0, Leave PWM Output High Low
          STA     CurVal      ;Work With This Until Next RTI
          BSET    PWM,PORTB   ;Set PWM Output High
          BSET    0,STATUS    ;Set On Flag
          BSET    TOFR,TCSR   ;Clear Timer Overflow Flag
          BSET    TOIE,TCSR   ;Re-enable the TOF Interrupt
ExitRTI   RTI                 ;Return From RTIF Interrupt
          ORG     $03F8       ;Interrupt/Reset Vectors Start Here
          FDB     TimerInt    ;Timer Interrupt Routine
          FDB     Init        ;IRQ Vector (Not Used)
          FDB     Init        ;SWI Vector (Not Used)
          FDB     Init        ; Reset Vector
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a problem with the 'K1. Motorola provides free software to program the 'K1 directly from a PC parallel port. The program is called "prog05k.exe" and runs on PC/compatibles. Motorola also provides a number of freeware assemblers that will work with the '705 family. The filename for one of these assemblers is "casm05.exe." The only detail to remember for the 'K1 is to start the program at address $0200, using an "ORG $0200" directive at the start of your source code.

You can download the programming software, assembler and other goodies from Motorola's Freeware BBS by dialing 1-512-891-3733. The software is self-documented.

Supply and programming voltages must also be provided to program the 'K1. Supply voltage V_{cc} is +5 volts, while programming voltage V_{pp} is +16.5 volts. Shown in Fig. 5 is the schematic diagram for the inexpensive K1PGM programmer board with on-board V_{pp} and V_{cc} generation from a single 9-volt supply. The K1PGM was designed with low cost as the chief design criterion. To this end, it uses a TL497 switching regulator to generate V_{pp}.

The TL497 is widely available and can be found for less than $1 in many cases. Also to keep costs down, the connections for the PC-to-K1PGM interface cable are made directly to pads on the printed-circuit card, rather than through a DB-25 connector, which saves the cost of the connector and, more importantly, permits use of a single-sided pc-board design. The tradeoff is that it's more difficult to construct.

Potentiometer *P1* is used to calibrate V_{pp}. This adjustment will probably have to be made only once and makes selection of other component values less critical. You can Wire Wrap, breadboard or pc-mount the programmer circuitry according to your preference. If you want pc construction, use the actual-size artwork given in Fig. 6 to fabricate your own board. Finished PC boards and parts kits are also available for the K1PGM to make the job easier. The wiring guide for this board is shown in Fig. 7.

A more-expensive, but still quite reasonably priced, alternative is the 68HC705KICS offered by Motorola. This includes a board that contains the programmer described and an in-circuit simulator (ICS). The simulator is somewhere between the "burn-and-crash" method and a full-blown in-circuit emulator (ICE). It performs similarly to an ICE but in nowhere near real-time. It's 25 to 100 or more times slower than an actual 'K1 in a circuit. Its speed depends on the speed of the PC to which it's connected. The kit also includes an MC68HC705K1S ceramic DIP EPROM version of the 'K1, a $25 to $30 value by itself. The kit usually sells for around $200.

The MC68HC705K1 from Motorola is an easy-to-use and versatile small microcontroller that fills a number of roles effectively and inexpensively. The initial investment for programming equipment is quite small, permitting novices to get started easily using the 'K1. ■

By Hardin Brothers

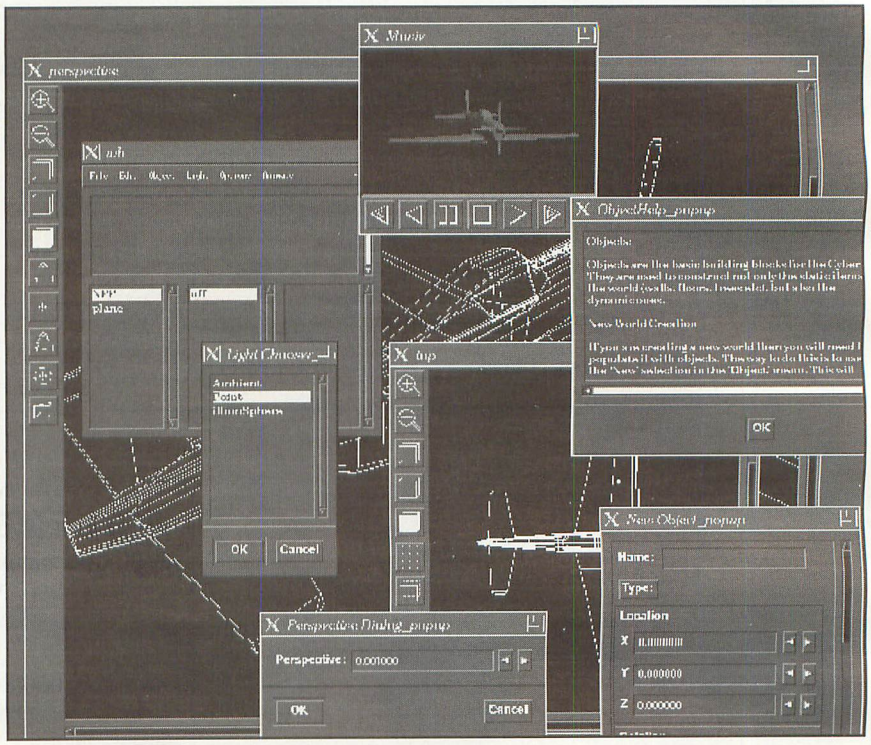
Virtual Reality On The Desktop

What's available, what you need and how you can get started

To hear the popular press and game makers tell it, the next big revolution in computers will be some kind of virtual reality, or VR for short. By putting on a helmet, gloves and body suit, we'll be able to move through a world created by the computer, picking up and moving objects and meeting with electronic people. This will be a "Gee Whiz!" world of holodecks like those on the *U.S.S. Enterprise* in *Star Trek, The Next Generation*, of virtual cadavers for surgeons to practice on, of graphical data for stock brokers to browse, of proposed buildings for architects to walk through and refine, of giant molecules for biochemists to explore and of tiny galaxies for astronomers to study.

This all sounds like fun, but current experiments in VR, at least those in the popular press and in darkened booths at trade shows, require hundreds of thousands of dollars in high-speed computers, advanced interface boards and exotic equipment.

If all you have is a generic desktop computer, you might feel left out. But VR has become the new passion of those who like to experiment with their home computers. You don't need an exaggerated bank account, an advanced laboratory and teams of specialists to experiment with VR, just some willingness to make a few mistakes while you create virtual worlds of your own.



This is a screen shot of the *Multiverse World Builder*, an application that creates virtual worlds under the X-Windows operating system.

VR Defined

Every researcher seems to have his or her own definition of virtual reality. For some, it's a collection of specific technologies—often a head-mounted three-dimensional video display, a glove input device and 3D audio. For others, VR is any interactive, computer-mediated system.

Perhaps the best way to think of VR is that it's a way for humans to visualize, manipulate and interact with a computer and complex data. In Michael Crichton's book *Disclosure*, VR is used to search a collection of complex databases and spy on someone who's trying to delete incriminating data. On the *U.S.S. Enterprise* in *Star Trek, The Next Generation*, VR is embodied in the holodeck, a special room in which a computer creates any reality from an alien world to Sherlock Holmes' London.

The military uses VR to build a new class of simulators for pilots and tank operators. Medical schools and hospitals use it to create virtual cadavers that teach surgeons complex procedures. It's used in research laboratories to explore complex biochemical molecules and the distribution of galaxies in the universe. And it's being used by businesses to help planners understand financial data, let architects walk through buildings before they're erected and let mechanics view diagrams of parts overlaid on the systems they're servicing.

"Real" VR seems to boil down to three things. It's immersive, interactive and convincing. When you enter a virtual world, you should be immersed in it. Listening to a radio pro-

gram, viewing television or sitting in front of a computer screen doesn't provide the same kind of immersion. The outside or "real" world is still with you and likely to intrude at any moment in time. A virtual world becomes reality when you enter it and the world around you is excluded.

VR must also be interactive. Movies and TV may seem immersive to some people, but they aren't interactive at all. You can't decide to look behind the desk or follow a character who catches your attention. In a virtual reality, you control the flow of events. You decide where to go, what objects to look at and manipulate and when to leave, just as you do in the real world. The computer, or VR engine, must adapt to your decisions, not script out the experience ahead of time.

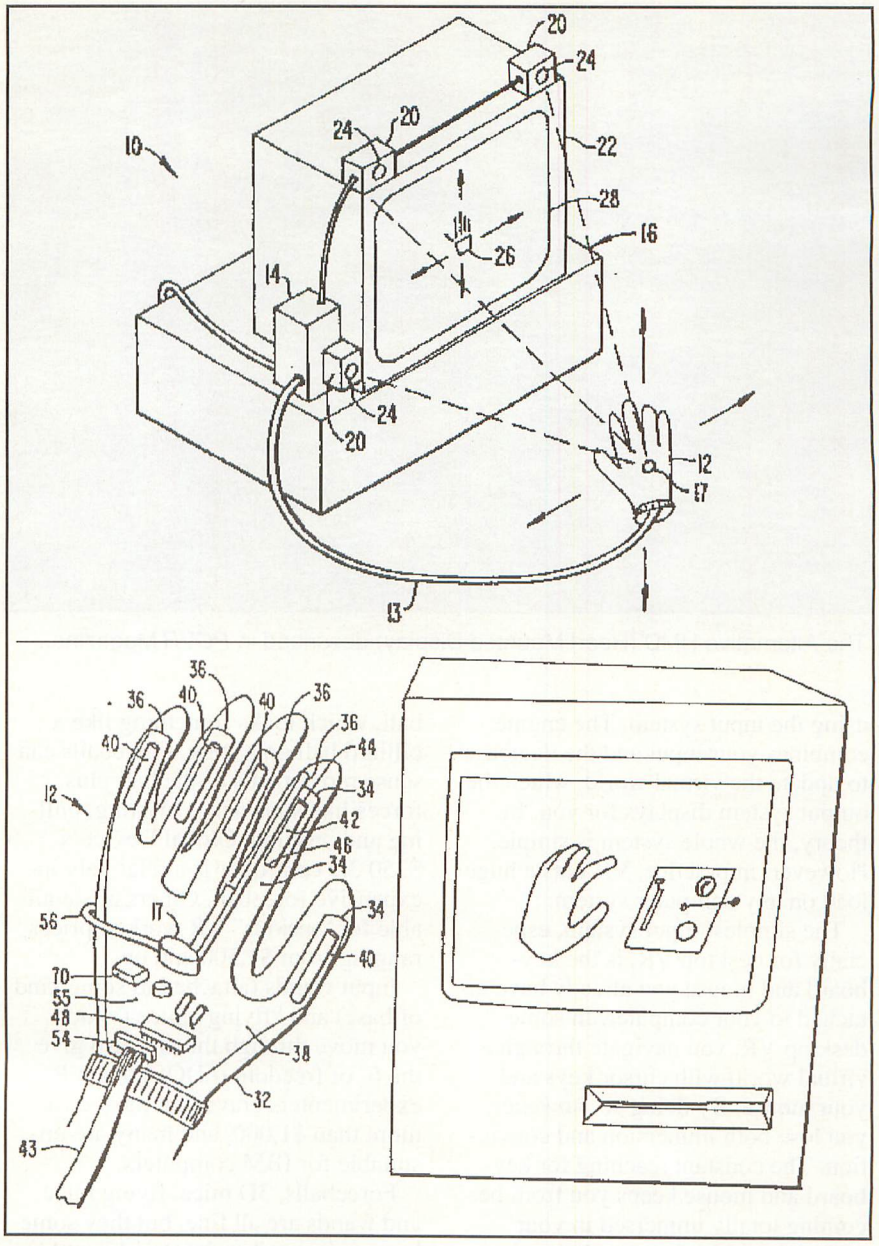
Finally, VR must be convincing. You should lose the sense that you're working with a computer. If you ride a motorcycle in a virtual world, you should feel as though you're riding, and controlling, the motorcycle, not sitting in a simulation cockpit.

Virtual Systems

Not all VR systems are created equal, of course. The most primitive type are called Window on the World (WoW) systems, which were first described by Ivan Sutherland in 1965. His ideas laid the groundwork for almost all computer graphics that have been developed over the past 30 years. "One must look at a display screen as a windows through which one beholds a virtual world. The challenge...is to make the picture in the window look real, sound real, and the objects act real."

A variation on this theme is to merge the user's silhouette in a 2D graphic display. The Mandala system, which appears on the Nick Arcade on the Nickelodeon cable-TV channel, uses this kind of mapping to put contestants into what looks like a large video game.

Immersive systems often use a head-mounted display (HMD) to hold the computer's visual and, often, auditory outputs. The HMD may be free ranging, tethered through an umbilical cord, or attached to a boom. Some systems use multiple large-screen projections in a "cave" or small room to let one or more people explore a virtual world together.



Two of the drawings from the patent for VPL Research's original DataGlove. All virtual-reality gloves, from Mattel's PowerGlove to those used in advanced VR, are derived from this glove and patent.

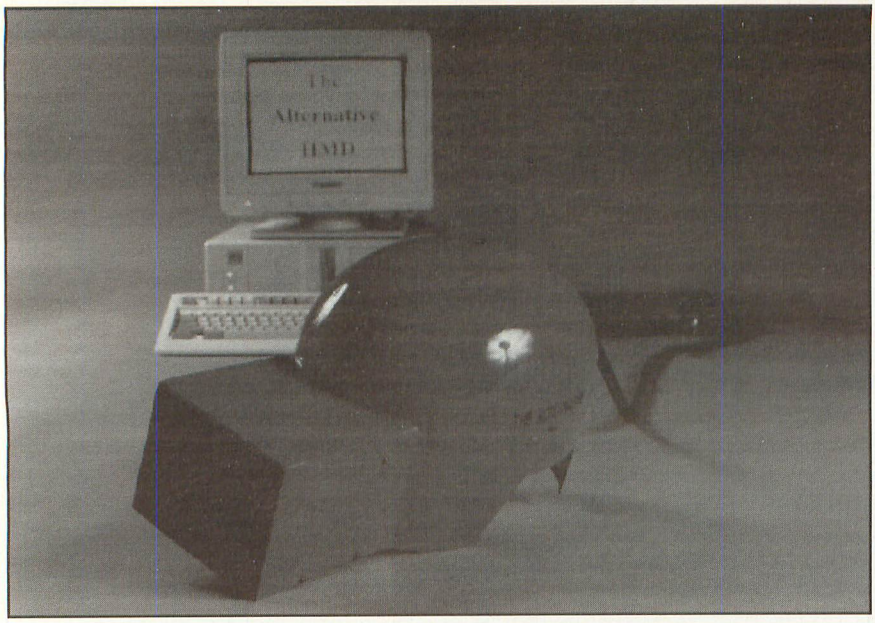
Telepresence systems link remote sensors to an immersive system. With such a system, a human can control a robot or delicate instruments. Robots controlled by telepresence are used to fight fires in dangerous conditions, explore volcanoes and the ocean floor, and perform delicate surgery without cutting a major hole in the patient.

Finally, mixed reality or seamless simulation systems merge computer output with telepresence or the real world. Fighter pilots may see computer-generated maps and data displays overlaid on an actual view of the target. Surgeons can view CAT scans or real-time ultrasound images overlaid on the actual view of a patient's brain.

You're probably not going to be able to create a set of tools for brain surgery with your desktop computer, but you can try out many of these types of VR with a small investment and some experimentation.

VR Requirements

A virtual-reality system can be divided into an input system, a world database, a reality engine and an output system. You react with the world by



The Alternative HMD (Head Mounted Display) described in *PCVR* Magazine.

using the input system. The engine combines your input and the database to update the virtual world, which the output system displays for you. In theory, the whole system is simple. However, in practice, VR puts a huge load on any computer system.

The simplest input system, especially for desktop VR, is the keyboard and mouse you already have attached to your computer. In some desktop VR, you navigate through a virtual world with cursor keys and your mouse. By doing so, however, you lose both immersion and conviction. The constant reaching for keyboard and mouse keeps you from becoming totally immersed in your virtual world, and you end up using artificial instead of convincing means of interacting with that world.

One step up from the traditional mouse are mice that include a thumbwheel or other device to indicate movement along the Z (or vertical) axis, like the $250 Z-Mouse from Multipoint Technology. Logitech's $129 CyberMan lets you move along the Z axis by pulling up and pushing down. It also can sense forward and backward pitch, left and right yaw, and side-to-side roll. Its 6 "degrees of freedom" (position along the X, Y and Z axes along with pitch, roll, and yaw) make it one of the least-expensive commercial products that can be used for true 3D virtual reality.

Another 3D controller is a forceball, which looks something like a billiard ball on a stick. Forceballs can sense movements of the ball plus forces like squeezing, twisting, pulling and pushing. Global Device's $250 3D controller is a relatively inexpensive forceball. Others are available for "serious" VR work at prices ranging from $1,500 and up.

Input wands (attached to some kind of base) and "flying" mice (which you move through the air) also give the 6° of freedom (6DOF) that VR experimenters crave, but most cost more than $1,000, and many are unsuitable for IBM computers.

Forceballs, 3D mice, flying mice and wands are all fine, but they somehow seem too "computer-ish" and unnatural for true VR use. One of the ideals of many VR experimenters is a head-mounted display (HMD) with added position-sensing equipment. With such an HMD, head movements can be translated into input signals that can move you through your computerized world.

HMDs, especially those with positioning sensors, are very expensive. Therefore, the input device of choice for many desktop VR experimenters is a Mattel Power Glove. Mattel manufactured and sold about 1.3-million Power Gloves between 1989 and 1991 as a Nintendo accessory. Even if you can find one in an "antique" store, buy one from a child or steal one from your nephew, you can't plug a Power Glove directly into your PC. You'll have to make (or buy) an interface that will send signals from the glove to your computer and vice-versa. Fortunately, the wiring for *this* is simple.

If your PC has a bi-directional parallel port, all you will need is 5 volts of power (which you can steal from your keyboard connector) and a male DB-25 connector. If you have an extra Power Glove, you can even turn it into a head tracker to add to whatever HMD you use.

Power Gloves are fun to use but they may not be accurate enough for serious VR work. If accuracy is important, a Z-mouse or CyberMan may be a better choice.

VR Output

With a little thought and experimentation, you can make your own input system or adapt the mouse and keyboard you now use. Creating an acceptable output system is more difficult, unless you're content to use your current video monitor and sound card.

If you want to create an immersive VR system, you need a video system that's more immersive than a plain computer monitor, which fails on three counts because it isn't stereoscopic, it isn't immersive and it has much too small a field of view (FOV). The FOV problem is the most nagging.

Our eyes let us see more than 180° horizontally and about 150° vertically without moving our heads. A convincing and immersive VR system will have to use as much of this FOV as possible. Some experts say the sense of presence or immersion does not really begin until your display fills at least 80° to 85° of your FOV.

Additionally, your screen is monoscopic, which means it presents only a single view at a time. Normal vision is stereoscopic, with a slightly different view in each eye. If you want a truly immersive system, you need a stereoscopic, colored, highly-detailed display, preferably in a head-mounted frame. Well, maybe. If you buy such a display commercially, you'll pay $2,500 or more, and this doesn't include the high-speed video cards (one for each eye, of course) and the RGB-to-NTSC converters you need to use it. With some cleverness, you could create an HMD by using the small

The SpaceMouse, one of several mice created for 3D design and virtual-reality applications, is manufactured by VR Technologies GmbH.

monochrome monitors from a pair of video recorders, plus some optics to spread each display to a wider FOV.

Unfortunately, such a display may be unhealthy. Many VR enthusiasts shy away from placing CRT tubes so close to their eyes for extended periods of time. Although no conclusive evidence exists to support the argument that radiation from CRTs can be harmful, they don't want to take the risk. Instead, many home-made HMDs use LCD TVs instead of traditional CRTs. According to PCVR magazine, one of the leaders in low-cost, PC-based VR, it's possible to build an HMD from Casio LCD TVs for about $450.

Another possibility is LCD shutter glasses. These are glasses with a single display in front of both eyes. With an LCD lens between each eye, the display can open and close almost instantaneously with a signal from the computer. The computer displays a view for the right eye, opens the right lens, closes the lens, displays a view for the left eye, opens and closes its lens, and then repeats the process. If the flipping occurs fast enough (about 60 times per second), you won't notice the flicker and you'll have an effective stereoscopic viewer.

You can buy shutter glasses made for VR systems or find old Sega or Toshiba glasses made for video games (they're no longer manufactured). These require a little more circuitry than a Power Glove to hook into a PC, but not much. A couple of transistors, a couple of capacitors and resistors, and a quad XOR gate will do the trick.

Even less expensive, you can buy a hood that goes over your video monitor to give stereoscopic views of data. Your software places each view on one side of the monitor, and the hood combines them, with optics, in a way that's reminiscent of old-fashioned stereopticons that you can sometimes find in antique stores. Or, you can make a hood of black matte paper, welding goggles and an inexpensive Fresnel lens to increase the FOV of your monoscopic monitor to an acceptable 80° or more. Perhaps the least-expensive solution for 3D viewing is to create red and blue monochrome images and combine them so that, with a pair of 3D comic-book glasses, you can see a scene in three dimensions.

Adding Sound

You may want a virtual world that has sound as well as sight. Adding sound presents several problems, none of them insurmountable. The first is that your virtual world will probably speed up and slow down, depending on the complexity of each scene and object and on the amount of movement you ask of it. However, it's nearly impossible to vary the playback speed of sound without introducing several kinds of distortion.

Second, stereo sound, which is easy to work with, isn't the same as the 3D sound needed for a convincing virtual world. In a stereo system, each sound is placed along an imaginary horizontal line that runs from one side of our head to the other. However, real-world sound comes from all around us.

We locate the source of a sound with our ears by relying on subtle clues, such as differences in volume (the technique used in stereo systems), time and phase differences and frequency attenuation differences. We can locate sounds in space because of the shape of our ears, the distance from one ear to another, the sound shadow created by our heads and the way sound reflects off our faces and shoulders.

Only a few commercial systems can create 3D sound. One stems directly from research conducted at NASA Ames Research Center and costs about $15,000. That's top-of-the-line but much too expensive for home use. Even the $1,800 Beachtron and $1,200 Focal Point cards cost too much for most home VR experimenters. But the $250 Advanced Gravis UltraSound card includes 3D capabilities, as does every Creative Labs SoundBlaster made after October 24, 1993. The QSound (3D) portion of the SoundBlaster works only with speakers (the 3D illusion is lost with headphones). And, of course, none of the lower-cost cards can place sounds nearly as accurately as the advanced, $15,000 systems.

In addition to sound, some VR systems use motion and tactile feedback to add to the reality of their virtual worlds. As far as I know, however, no one has found an inexpensive way to add either to desktop VR.

Database & Engine

Although I've left it for last, the most important part of any VR system is the computer, or computers, on which it runs. The computer must accept input, update its internal representation of the virtual world and then create the necessary output, all as quickly as possible. Ideally, the computer should be able to draw output images as quickly as a movie or TV, at 24 to 30 frames per second (fps). In practice, even high-powered laboratory systems sometimes have difficulty running at more than 15 to 22 fps.

The problem with slower frame rates is that the user notices a lag, or latency, between giving a command to the system, perhaps by swiveling his or her head or moving a mouse, and the system's response. In a VR system with an HMD and head-position tracking, a delay of a 0.1 to 0.25 second can cause headaches, dizziness and even nausea. The more immersive a system is, the faster it must react to convince users that the virtual world is "real."

Of course, the more-complex the virtual world, and the more-complex the video representation of that

world, the longer it will take the computer to generate each frame.

Most VR software represents each object in the virtual world as a series of polygons. To generate a frame, the computer must decide which objects are in view, which polygons of each view object must be displayed, how to draw each polygon and then how to color, texture and shade each polygon. Finally, the entire frame must be transferred to the video card for visual display.

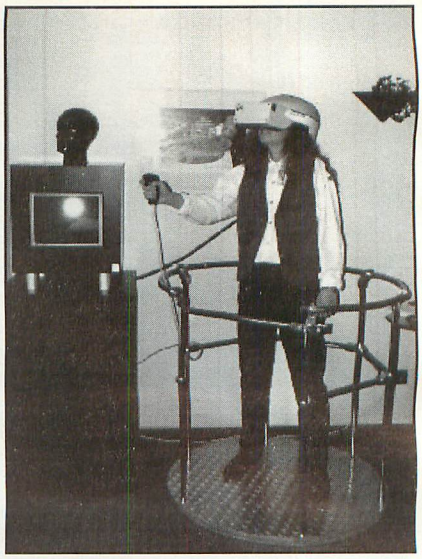
If you can offload some of the work from the main CPU, the frame rate will go up significantly. It's often possible to pre-process the inputs, especially on head-tracking and Power Glove systems, by using a different (and perhaps slower) computer. If you have a graphics accelerator card with its own shape processor, you can hand it many of the rendering tasks while the CPU calculates changes in the virtual world and point-of-view. Of course, doing all of this assumes programming skills, usually in C/C++ and assembly language.

Writing the code for a VR engine could take months. One way to avoid the delay is to buy a commercial VR package, but few of these have the flexibility to support experimental input and output devices. They work fine (and sometimes cost a great deal) if you're using a VGA monitor and mouse, for example, but not if you're attempting to add a Power Glove and Sega LCD shutter glasses. The classic program for desktop VR on a PC has been *REND386*, a freeware rendering program written by Bernie Roehl and Dave Stampe.

REND386 is written for programmers. Although a demonstration version is available, if you want to take advantage of all of its features and add your own hardware, you must be able to write your own modules in Borland's Turbo C and add them to the *REND386* source code. Also, Roehl and Stampe are no longer supporting *REND386*. Roehl has released a new freeware program, *AVRIL*, that's similar to and faster than *REND386*. Like its predecessor, *AVRIL* expects that you can program in Turbo C Version 3 if you want to do more than run a few demos. On my 50-MHz 486 computer, *AVRIL* can run its demonstration program at 12 to 25 fps through a normal VGA system.

Neither *REND386* nor *AVRIL* includes a world editor, a program to create the objects in the virtual world. You can use any 3D CAD program that can save files in .DXF format and then use a freeware converter program to convert the files into the .PLG format that both programs require.

There are commercial VR programs as well. One of the most popular inexpensive programs is the $90 *Virtual Reality Studio* from Incentive Software. This program lets you define a move through a virtual world. A free demonstration program, *VRSDEMO*, is available for downloading from several sources. *VREAM*, from VREAM, Inc., is a popular high-end modeling and playback program for DOS systems that includes a powerful scripting language and support for a wide variety of input and output devices. Its retail price is $795.



The VirtualWorldExplorer (VWE) is an immersive VR system configured for arcades and fairs. It consists of parallel CPUs for high-performance, full stereo-vision and can be configured with nearly any piece of VR equipment (gloves, HMDs, etc.). VWE is available from VR Technologies GmbH.

Locating Information

Both desktop and professional VR are changing rapidly. The best way to find up-to-date information is electronically. Two discussion areas are particularly helpful: the CYBERFORUM on CompuServe and the USENET news group called sci.virtual-worlds. You can download documents, programs, and demos from the CYBERFORUM or, if you have access to the Internet, you can use anonymous FTP to get many of the same files plus several others from ftp.u.washington.edu in the /public/virtual-worlds/ directory and from sunee.uwaterloo.ca starting in the /pub/ directory. There are several VR publications. Perhaps the best for home-brew VR is the unpretentious *PCVR* magazine (call 608-877-0909 for information). The best books I've found are *Garage Virtual Reality* by Linda Jacobson (SAMS Publishing) and *The Virtual Reality Construction Kit* by Joe Gradecki (Wiley).

Virtual reality is still experimental. You can become one of the experimenters for a modest investment if you're willing to add some time, imagination and both hardware and programming skills. Though in a couple of years it may become a mass-market technology, for now, at least on a desktop computer, it's in the hands of those who like to tinker and explore new ways of working with their computers. ■

By Fred Eady

Getting to Know the PIC17C42

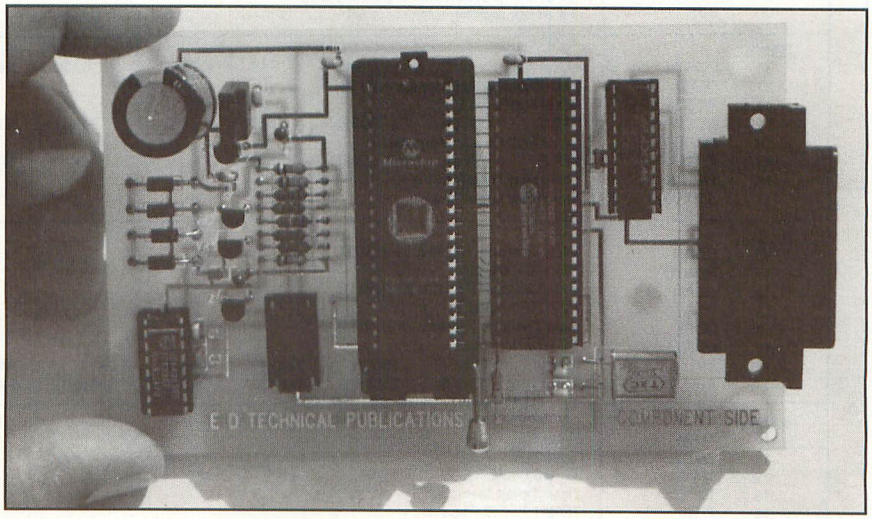
How to use this robust 16-bit RISC-like wonder and building a Programmer for it

Microchip Technology's PICs consist of a truly wondrous set of microcontrollers. Their ease-of-use, ready availability, small size and low power consumption make the PIC16CXX series difficult to beat. For most applications, their amount of internal program memory and standard set of I/O pins are adequate. With PIC16C5X clock speeds reaching the 20-MHz mark, these devices hold their own in performance, too.

Even with such impressive features, an application sometimes emerges that requires more resources than the 12- and some 14-bit PIC devices can deliver. For instance, the PIC16C5X Programmer kit I've made reference to in past *MicroComputer Journal* PIC tutorials could have easily been built with a 12-bit PIC device. To eliminate extra TTL silicon that would have been required to support the 12-bit PIC, I used another superb Microchip product—the awesome PIC17C42—which let me eliminate an external UART, several open-collector driver stages and additional TTL I/O chips.

On the software side, the cursory RS-232 serial routines I'd normally have had to write were eliminated. In addition, the PIC17C42 is endowed with a more-robust 16-bit instruction set that let me write faster and more-powerful application code with fewer instructions.

In this article, I describe a working PIC17C42 hardware and software example you can easily assemble on the PIC Breadboarding System I described last issue to show just how easy it is to use the PIC17C42. I'll detail a low-cost PIC17C42-based PIC17C42 Programmer you can build and that programs both EPROM-based and OTP (one-time programmable) plastic PIC17C42s.



The PIC17C42

Like its relatives, the PIC17C42 is RISC-like and uses a modified Harvard architecture in which data and program are accessed from separate memories. Memory separation permits the program and data memories to be sized differently.

The PIC17C42 uses a 16-bit single-word instruction in conjunction with a conventional eight-bit data path. Each instruction is fetched in a single cycle. Instruction fetch and execution are pipelined so that fetch executes in one cycle, decode and execution in another cycle. Thus, each instruction effectively executes in one cycle.

Most of the PIC17C42's 55 instructions can be executed in a single 160-ns cycle with a 25-MHz processor clock. Exceptions are program branches and two special data-transfer instructions.

The PIC17C42 can address a total of 64K X 16 words of program memory. It also contains 2K X 16 words of on-chip EPROM program memory.

A unique feature of the PIC17C42 is that it's able to address program memory in one of four modes: Microcontroller Mode, Microprocessor Mode, Extended Microcontroller Mode and secure Microcontroller Mode.

Table 1. FPMXX Fuse Combinations

FPMM0	FPMM1	Mode
0	0	Microcontroller Mode (Code Protected))
0	1	Microcontroller Mode (Unprotected)
1	0	Extended Microcontroller Mode
1	1	Microprocessor Mode

Table 2. PIC17C42 Register and File Summary

Filename		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0	Value on power on reset	Value on all other reset (note3)	
UNBANKED:												
00	INDF0	Uses contents of F1 to address data memory (not a physical register)								00000000	00000000	
01	FSR0	Indirect data memory address pointer 0								xxxxxxxx	uuuuuuuu	
02	PCL	Low order 8 bits of PC								00000000	00000000	
03	PCLATH	Holding register for upper 8 bits of PC (Note 1)								xxxxxxxx	uuuuuuuu	Note 1
04	ALUSTA	FS3	FS2	FS1	FS0	OV	Z	DC	C	1111xxxx	1111uuuu	
05	RTCSTA	INTEDG	RTEDG	T/C	RTPS3	RTPS2	RTPS1	RTPS0	-	00000000	00000000	
06	CPUSTA	-	-	STKAV	GLINTD	TO	PD	-	-	00111100	001177u0	Note 2
07	INTSTA	PEIR	RTXIR	T0IR	INTIR	PEIE*	RTXIE	T0IE	INTIE	00000000	00000000	
08	INDF1	Uses contents of F9 to address data memory (not a physical register)								00000000	00000000	
09	FSR1	Indirect data memory address pointer 1								xxxxxxxx	uuuuuuuu	
0A	W	W register								xxxxxxxx	uuuuuuuu	
0B	TMR0L	Timer0 Low byte								xxxxxxxx	uuuuuuuu	
0C	TMR0H	Timer0 High byte								xxxxxxxx	uuuuuuuu	
0D	TBLPTRL	Low byte of program memory table pointer								xxxxxxxx	uuuuuuuu	
0E	TBLPTRH	High byte of program memory table pointer								xxxxxxxx	uuuuuuuu	
0F	BSR	Bank select register								00000000	00000000	
BANK0:												
10	PORTA	PUEB	-	RA5	RA4	RA3	RA2	RA1/RT	RA0/INT	00xxxxxx	00uuuuuu	
11	DDRB	Data Direction Register for PORTB								11111111	11111111	
12	PORTB	PORTB data latch								xxxxxxxx	uuuuuuuu	
13	RCSTA	SPEN	RC8/9	SREN	CREN	-	FERR	OERR	RCD8	0000000x	0000000u	
14	RCREG	Serial Port Receive Register								xxxxxxxx	uuuuuuuu	
15	TXSTA	CSRC	TX8/9	TXEN	SYNC	-	-	TRMT	TXD8	0000001x	0000001u	
16	TXREG	Serial Port Transmit Register								xxxxxxxx	uuuuuuuu	
17	SPBRG	Baud Rate Generator								xxxxxxxx	uuuuuuuu	
BANK1:												
10	DDRC	Data Direction Register for PORTC								11111111	11111111	
11	PORTC	PORTC data latch								xxxxxxxx	uuuuuuuu	
12	DDRD	Data Direction Register for PORTD								11111111	11111111	
13	PORTD	PORTD data latch								xxxxxxxx	uuuuuuuu	
14	DDRE	Data Direction Register for PORTE								00000111	00000uuu	
15	PORTE	PORTE data latch								00000xxx	00000uuu	
16	PIR	IRB	TM3IR	TM2IR	TM1IR	CA2IR	CA1IR	TBMT	RBFL	00000010	00000010	
17	PIE	IEB	TM3IE	TM2IE	TM1IE	CA2IE	CA1IE	TXIE	RCIE	00000000	00000000	
BANK2:												
10	TMR1	Timer1								xxxxxxxx	uuuuuuuu	
11	TMR2	Timer2								xxxxxxxx	uuuuuuuu	
12	TMR3L	Timer3 Low byte								xxxxxxxx	uuuuuuuu	
13	TMR3H	Timer3 High byte								xxxxxxxx	uuuuuuuu	
14	PR1	Timer1 Period Register								xxxxxxxx	uuuuuuuu	
15	PR2	Timer2 Period Register								xxxxxxxx	uuuuuuuu	
16	PR3L/CA1L	Timer3 Period Register, low byte/capture1 register, low byte								xxxxxxxx	uuuuuuuu	
17	PR3H/CA1H	Timer3 Period Register, High byte/capture1 register, high byte								xxxxxxxx	uuuuuuuu	
BANK3:												
10	PW1DCL	DC1	DC0	-	-	-	-	-	-	xx000000	uu000000	
11	PW2DCL	DC1	DC0	TM2PW2	-	-	-	-	-	xx000000	uu000000	
12	PW1DCH	DC9	DC8	DC7	DC6	DC5	DC4	DC3	DC2	xxxxxxxx	uuuuuuuu	
13	PW2DCH	DC9	DC8	DC7	DC6	DC5	DC4	DC3	DC2	xxxxxxxx	uuuuuuuu	
14	CA2L	Capture2 low byte								xxxxxxxx	uuuuuuuu	
15	CA2H	Capture2 high byte								xxxxxxxx	uuuuuuuu	
16	TCON1	CA2ED1	CA2ED0	CA1ED1	CA1ED0	16/8	TMR3C	TMR2C	TMR1C	00000000	00000000	
17	TCON2	CA2OVF	CA1OVF	PWM2ON	PWM1ON	CA1/PR3	TMR3ON	TMR2ON	TMR1ON	00000000	00000000	

x = unknown
u = unchanged

Notes:

1: The upper byte of the program counter is not directly accessible. f03 is a holding register for PC<15:8> whose contents are updated from or transfered to the upper byte of the program counter.

2: The "TO" and PD" status bits in f06h are not affected by a "MCLR" reset. TO bit will be reset in the event of a WDT time-out reset.

3: Other (non power-up) resets include external reset through MCLR pin and Watchdog Timer timeout reset.

In Microcontroller Mode, only internal execution is permitted. This restricts the program to the internal 2K X 16 program memory space.

Another variation of Microcontroller Mode is Secure Microcontroller Mode, which enables code protection for the on-chip firmware.

Microprocessor Mode doesn't permit use to the 2K X 16 on-chip EPROM. Instead, the entire 64K X 16 program-memory area is mapped externally. This permits use of two eight-bit EPROMs to contain the firmware. Microchip Technology manufactures fast EPROMs for those who choose this mode of operation.

Extended Microcontroller Mode permits you to use the 2K X 16 on-chip EPROM, as well as the available external memory. Any read from or write to address 0x800 or beyond vectors to the external-memory area. External memory can be SRAM, EEPROM or EPROM, depending on the application.

You select modes by setting configuration fuses inside the PIC17C42. Fuses FPMM0 and FPMM1 determine mode of operation. FPMM0 is at 0xFE04, FPMM1 at 0xFE06. FPMMX fuse combinations are detailed in Table 1. A logical look at the memory

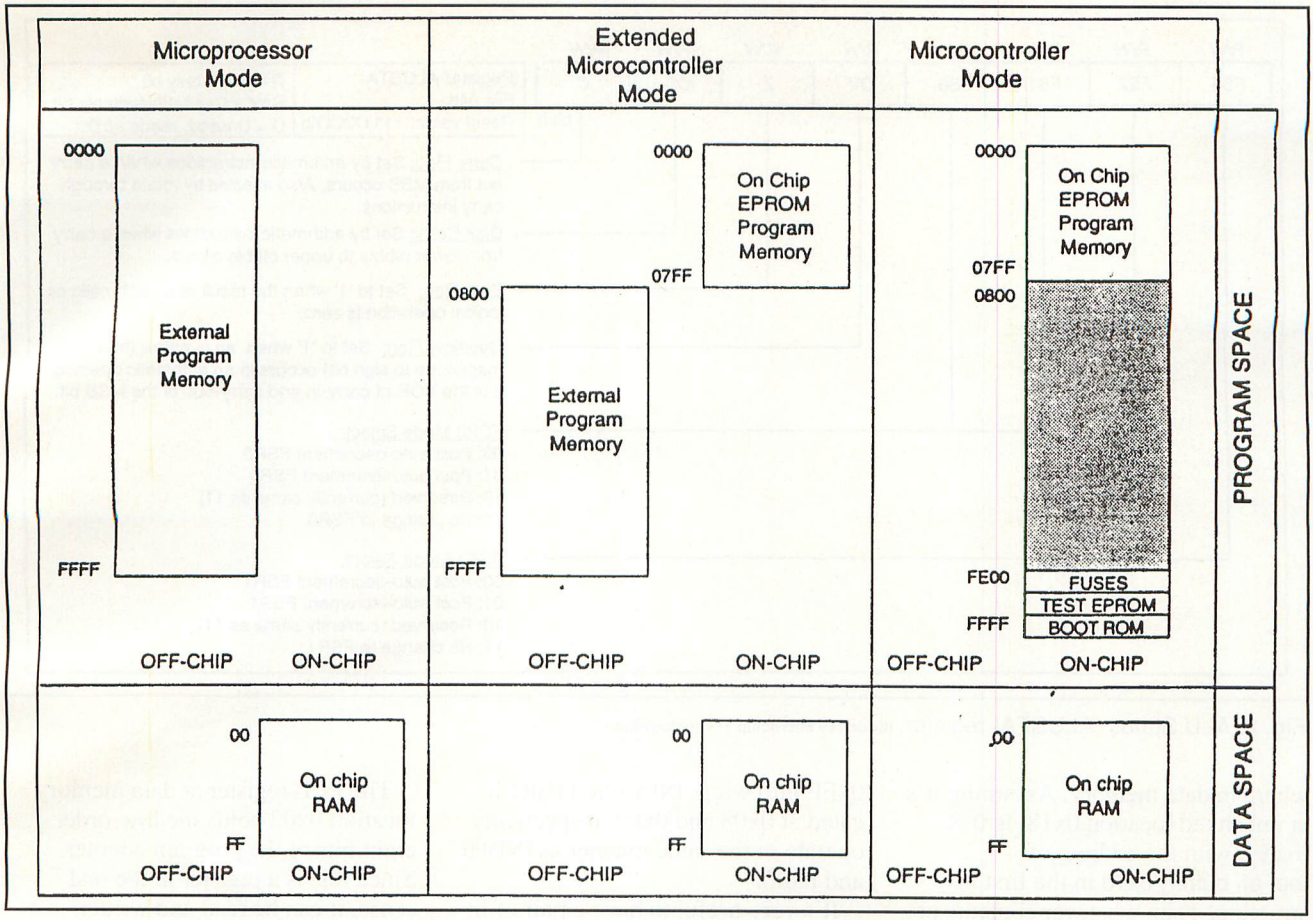


Fig. 1. PIC17C42's memory map in different modes. (Courtesy Microchip Technology Inc.)

organization of each mode is given in Fig. 1.

In addition to program memory, the PIC17C42 can directly or indirectly address 256 internal data memory locations or file registers. Most of this data memory is implemented as static RAM addressed from 0x18 to 0xFF. All special-function registers, including the program counter, are also mapped into this data-memory area.

Data-memory address and data buses aren't brought outside the IC, although data segments can be created in external program-memory space. Instructions TABLWT (Table Write) and TABLRD (Table Read) move data between external program memory and the register file. Table Pointer register TBLPTR assists in this transfer. The DL-1414 Scroller Program illustrates use of the Table instructions.

Due to the symmetrical nature of the PIC17C42 instruction set, any operation can be carried out on any register using any addressing mode. This makes the PIC17C42 very easy to learn and a pleasure to use.

Referring to Table 2, file registers 0x00 through 0x0F are "unbanked," which means that they can be used from any segment of the program without designation or regard to any particular bank being considered as active. Banks 0 through 3 share data-memory locations between 0x10 and 0x17.

You must activate each individual bank in accordance with the register to be used within a given bank. For instance, to use the serial registers, you must code the instruction MOVLB 0x00 (Move Literal Value to BSR) to logically activate Bank0 so that the Serial Port Receive and Transmit registers are available to the application. Likewise, to apply the Timers, use the instruction MOVLB 0x02 so that registers associated with the PIC17C42 Timers in Bank2 can be accessed.

Use the MOVLB instruction to load the Bank Select Register with the desired constant (0 through 3) that relates directly to each bank. The PIC-17C42 implements a bank scheme to conserve data RAM, at the same time providing a large number of special-purpose registers in the 256-byte data-memory area.

Each bank consists of logically-related functional elements. Bank Select Register BSR is located in the register file at 0x0F.

As with other members of the PIC family, file register 0x00, or INDF0, isn't physically implemented. The sole purpose of this register is to use the contents of register 0x01 (FSR0) to perform indirection within the application. In other words, FSR0 "points" to the actual location that will be operated on, but INDF0 is actually used in the instruction. Here's an example:

```
movpf   top_of_buffer, fsr0 ;load fsr0 reg
                            ister with
                            ;address of
                            top_of_buffer
movpf   indf0,wreg          ;load contents
                            of top_of_buffer
                            ;into working
                            register
```

Identifier top_of_buffer represents a physical location and exists some-

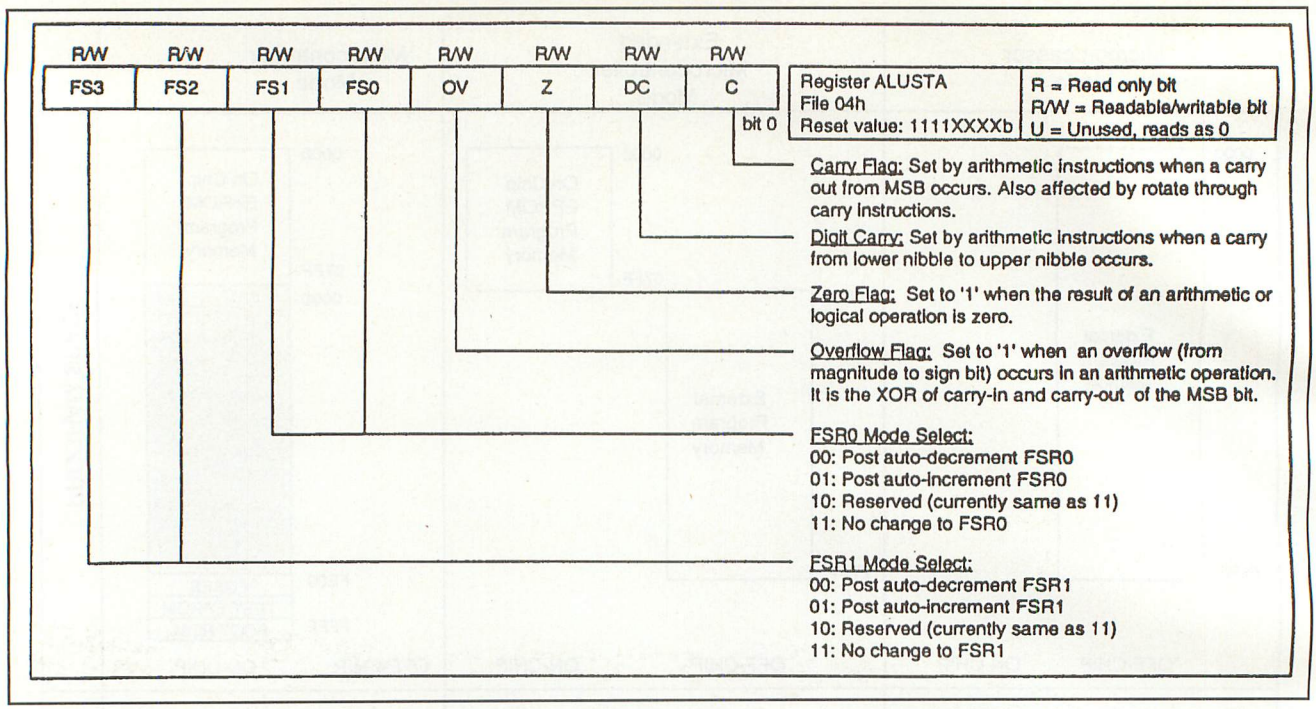


Fig. 2. ALU Status (ALUSTA) register. (Courtesy Microchip Technology Inc.)

where in data memory. Assuming it's at unbanked location 0x18, fsr0 is loaded with the address of top_of_buffer, 0x18 in the first instruction. Then whatever contents of location 0x18 get loaded into wreg.

Wreg is analogous to the accumulator in other micros. So, if location 0x18 contained the value 0xFF, the above program snippet would load 0xFF into wreg. INDF1 and FSR1 located at 0x08 and 0x09, respectively, operate in the same manner as INDF0 and FSR0.

It's very useful to have a pair of indirection registers when working with more than one memory array. A real-world example of how indirection is used can be found in the DL-1414 Scroller Program.

The PCL register at data memory location 0x02 holds the low-order eight bits of the program counter. Since this is a register in the real sense, it can be read and written just as any other register in the register file. This lets the programmer load the lower byte of the program counter directly from within the application. This very-powerful feature is useful

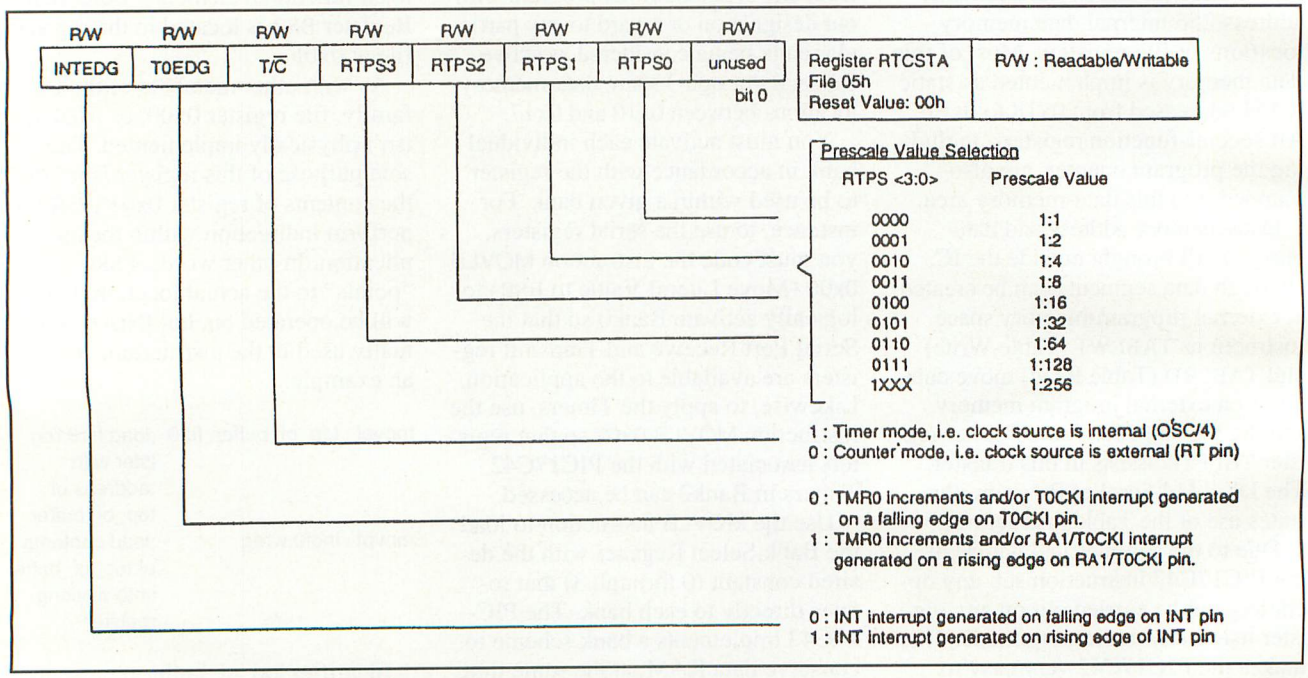


Fig. 3. RTCSTA: TMR0 Status/Control register. (Courtesy Microchip Technology Inc.)

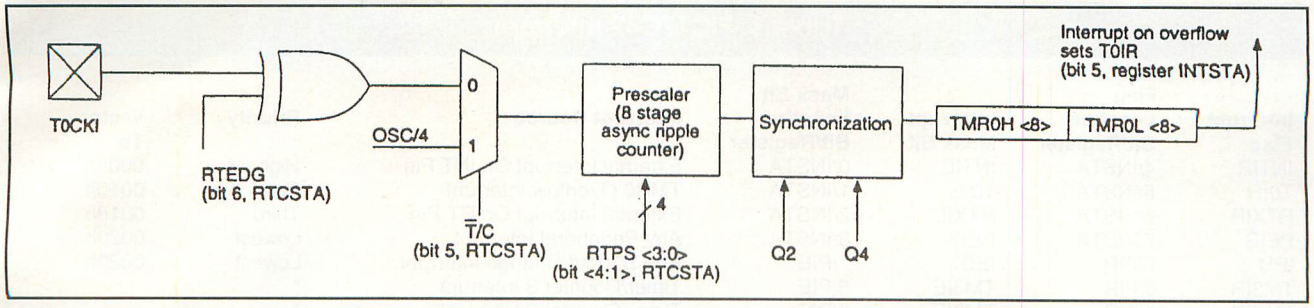


Fig. 4. Block diagram of the TMR0 module. (Courtesy Microchip Technology Inc.)

in performing real-time, program-calculated jumps.

Location 0x03 (PCLATH) is a holding register for the upper byte of the program counter. A holding register is required here because the upper half of the program counter isn't directly accessible. Data in this register is transferred to, or gathered from, the upper byte of the program counter.

ALU Status register ALUSTA contains flags that represent the results of operations performed by the Arithmetic and Logic Unit. These flags indicate if the operation resulted in a value of 0x00 or if the carry bit was set or cleared. Overflow and digit-carry (carry or borrow between lower and upper nibbles of a byte) conditions are also represented in the ALUSTA.

To facilitate such operations as setting up buffers and clearing and loading memory arrays, bits FS0 through FS3 permit an automatic increment or decrement function for indirect pointer registers FSR0 and FSR1. The logical layout of the ALUSTA register is shown in Fig. 2.

File register 0x05 is the TMR0 Status/Control Register, or RTCSTA. ("RTC" in RTCSTA stems from the old TMR0 name, which was RTCC. To standardize the name of this particular counter across the entire PIC line, Microchip has universally replaced the RTCC designation with TMR0.)

The TMR0 module is a combination of a 16-bit timer/counter, eight-bit prescaler and T0CKI pin that's the source for an external clock signal. The RTCSTA register contains control bits that determine how the TMR0 module operates.

As you can see in Fig. 3, four bits control the prescaler—a bit for the mode or clock selection, another to determine on which edge (leading or trailing) TMR0 increments and a bit to set the edge for interrupt generation. In Fig. 4 is a simplified block diagram of the TMR0 module.

CPU Status Register CPUSTA contains information on how the previous processor reset was initiated. Among the many ways the PIC17C42 can be reset is power-up and use of the SLEEP instruction, followed by a wake-up action, such as a WDT (Watchdog Timer) time-out.

CPUSTA also houses control bits for global interrupt control GLINDT and stack availability STKAV. CPUSTA is shown in Fig. 5.

The low-order nibble (four bits) of file register 0x07 controls the ability of the PIC17C42 to perform interrupt operations. The high-order nibble of file register INTSTA (Interrupt Status) holds the corresponding flags that status the respective interrupt.

PIC17C42 interrupt logic is con-

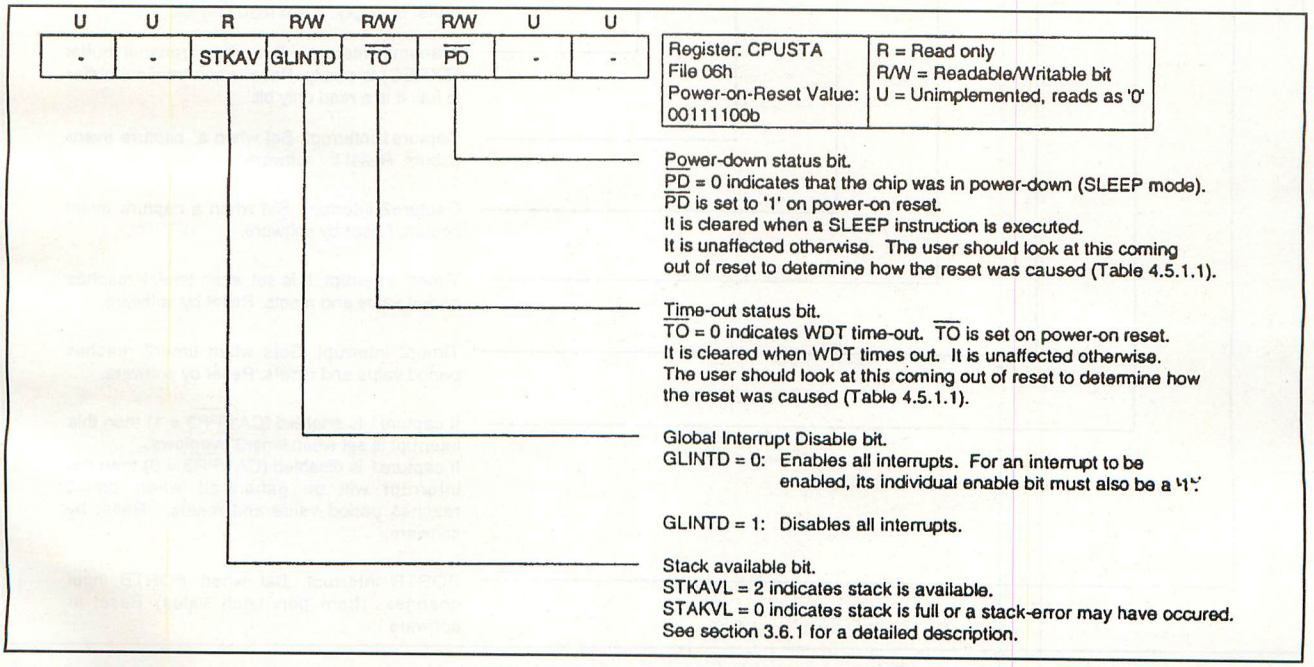


Fig. 5. CPUSTA register. (Courtesy Microchip Technology Inc.)

Table 3. PIC17C42 Interrupts

Interrupt Flag	Flag Location Bit/Register	Interrupt Mask Bit	Mask Bit Location Bit/Register	Interrupt Source	Priority	Vector To
INTIR	4/INSTA	INTIE	0/INSTA	External Interrupt On INT Pin	Highest	0008h
T0IR	5/INSTA	T0IE	1/INSTA	TMR0 Overflow Interrupt	Second	0010h
RTXIR	6/INSTA	RTXIE	2/INSTA	External Interrupt On RT Pin	Third	0018h
PEIR	7/INSTA	PEIE	3/INSTA	Any Peripheral Interrupt	Lowest	0020h
IRB	7/PIR	IEB	7/PIE	Port B Input Change Interrupt	Lowest	0020h
TM3IR	6/PIR	TM3IE	6/PIE	Timer/Counter 3 Interrupt	*	
TM2IR	5/PIR	TM2IE	5/PIE	Timer/Counter 2 Interrupt	*	
TM1IR	4/PIR	TM1IE	4/PIE	Timer/Counter 1 Interrupt	*	
CA2IR	3/PIR	CA2IE	3/PIE	Capture 1 Interrupt	*	
CA1IR	2/PIR	CA1IE	2/PIE	Capture 2 Interrupt	*	
TBMT	1/PIR	TXIE	1/PIE	Serial Port Transmit Interrupt	*	
RBFL	0/PIR	RCIE	0/PIE	Serial Port Receive Interrupt	*	

*All these peripheral interrupts are ORed together to generate PEIR.

trolled by the INSTA register, in conjunction with global interrupt control bit GLINDT in the CPUSTA register. The interrupts associated with the INSTA register have interrupt vectors that provide quick interrupt response time. In addition, each interrupt represented by the INSTA register has a mask bit and request bit assigned to it, as detailed in the first four entries Table 3.

This is a good time to include a look at the Peripheral Interrupt Request PIR register located in Bank1 at location 0x16. Referring to Table 3, the lower eight interrupt sources have the lowest priority and share a common interrupt vector at 0x20 in program memory. These are know as the peripheral interrupts because the interrupts originate from intelligent "peripherals" in the PIC17C42.

The interrupt flags reside in the PIR register. The associated interrupt mask bits are in the Peripheral Interrupt Enable PIE register in Bank1 at location 0x17. Details of the PIR register are shown in Fig. 6, the PIE register in Fig. 7.

The W register, also sometimes called "wreg" is simply a working register, hence w(orking)reg. You use wreg as you would an accumulator, but with much less restriction. Some PIC17C42 instructions deal directly with wreg, while other instructions

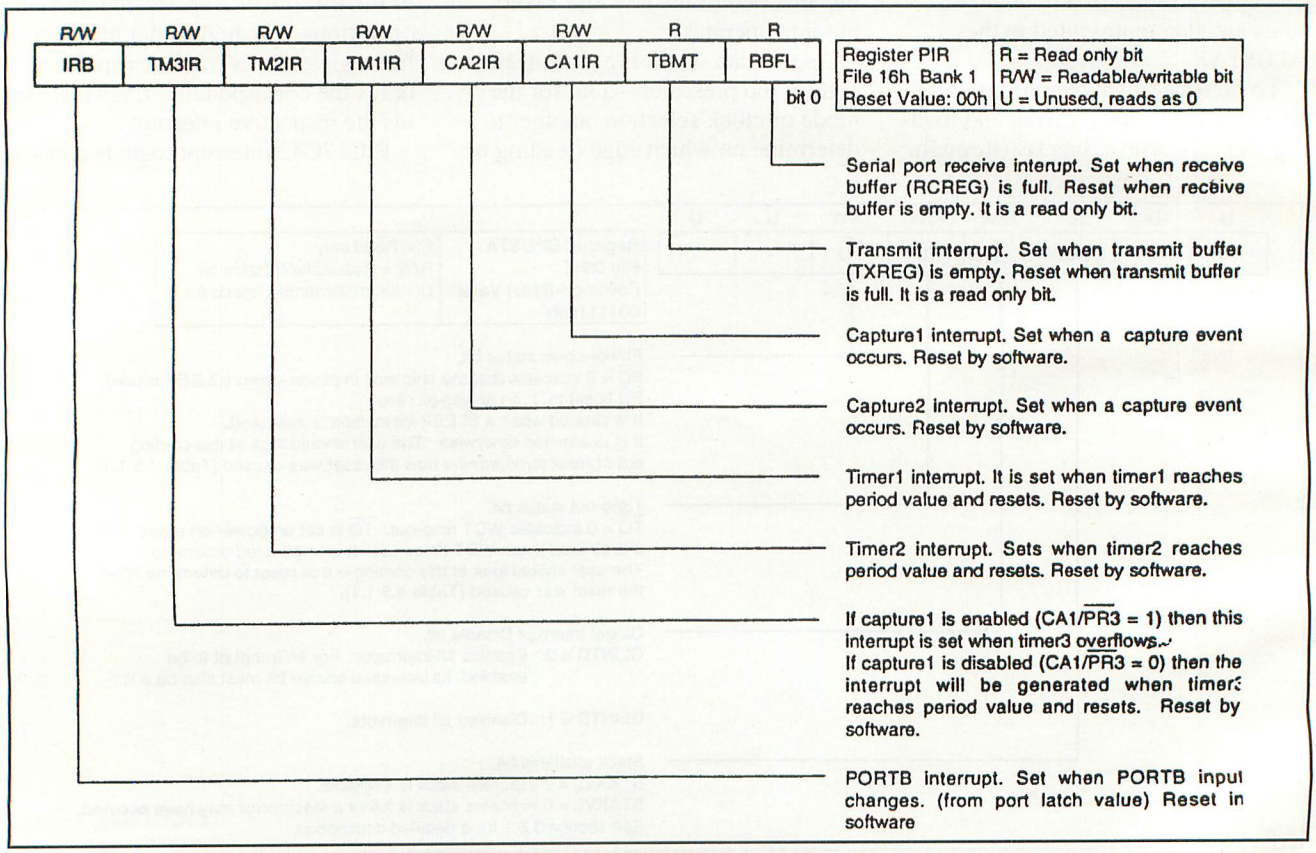


Fig. 6. Peripheral Interrupt Request (PIR) register. (Courtesy Microchip Technology Inc.)

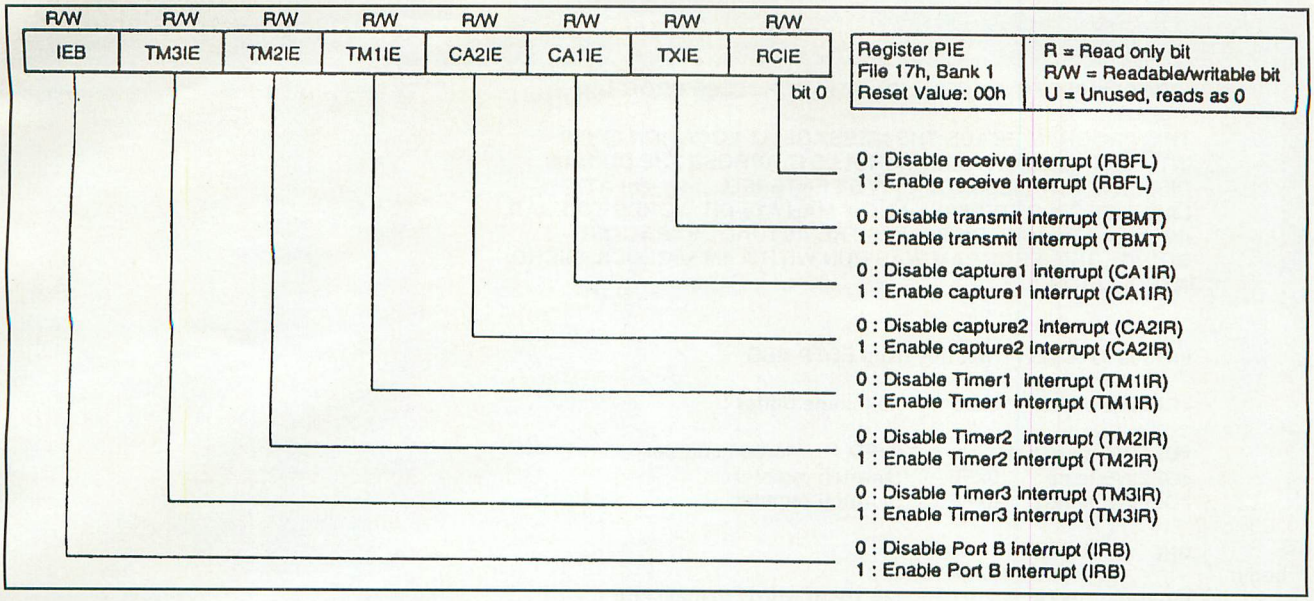


Fig. 7. Peripheral Interrupt Enable (PIR) register. (Courtesy Microchip Technology Inc.)

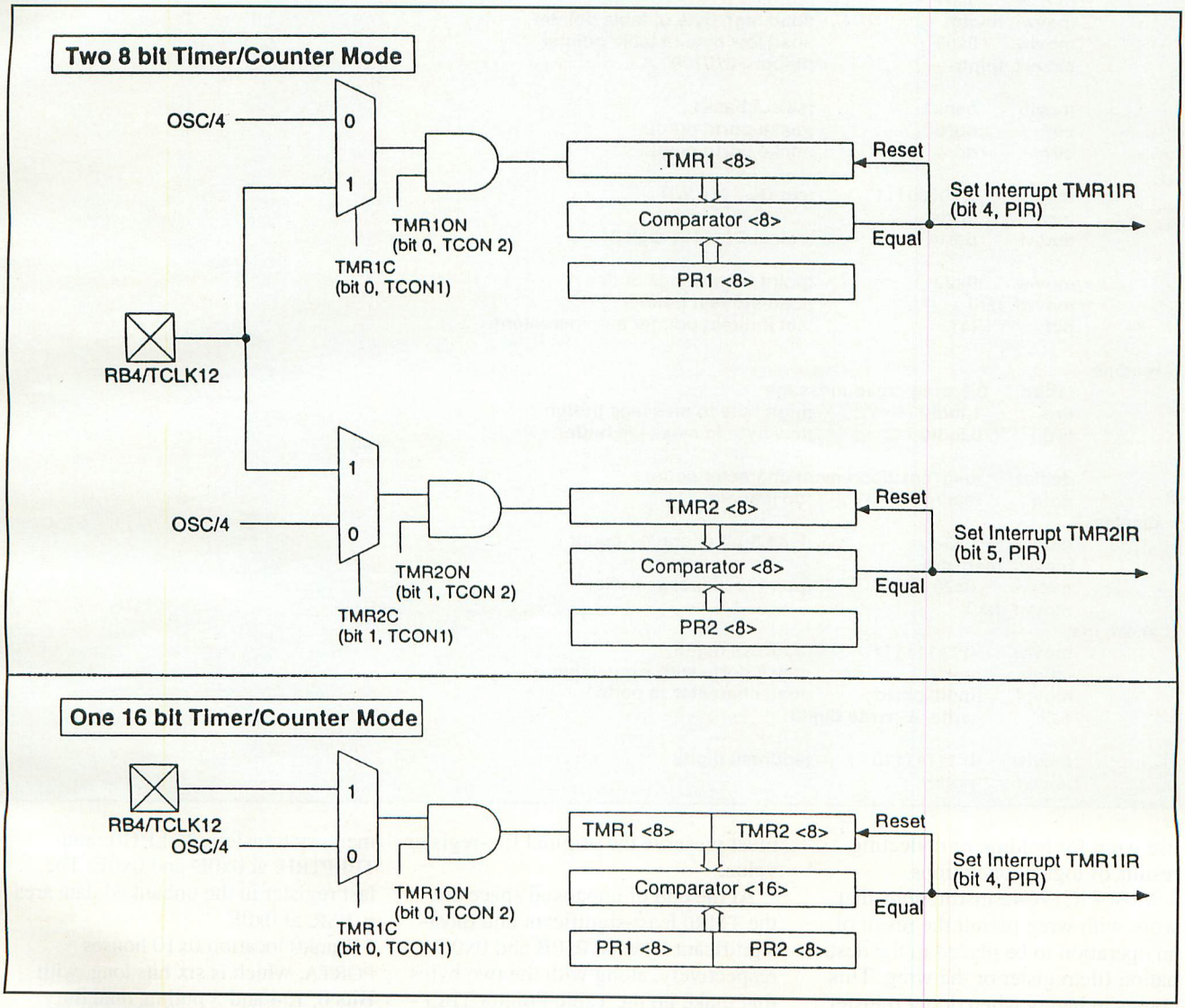


Fig. 8. Timer 1/Timer2 block diagram. (Courtesy Microchip Technology Inc.)

Listing 1. Program Listing For DL-1414 *Scroller*

```
;******** MICROCOMPUTER JOURNAL DL-1414 SCROLLER PROGRAM
;
;       THIS PROGRAM READS THE MESSAGE AT LOCATION 0X100
;       INTO DATA MEMORY AND SCROLLS IT ACROSS THE DL-1414
;       DISPLAY.  ANY MESSAGE CAN BE ENTERED.  msg_cnt AT
;       LABEL BEGIN DETERMINES HOW MANY 16-BIT WORDS TO LOAD.
;       msg_cnt AT LABEL DISPLAY IS THE ACTUAL CHARACTER
;       COUNT.  THIS PROGRAM WAS RUN WITH A 4MHz CLOCK, MICRO
;     CONTROLLER MODE.


        include "17C42.H" ;get this from EDTP BBS

        #DEFINE digits    0x20      ;message buffer

        #DEFINE msg_cnt             0xFD      ;screen counter
        #DEFINE temp      0xFE      ;scratch register
        #DEFINE temp1     0xFF      ;scratch register

        org       0x0000
begin
        movlw     0x1A              ;26 16-bit words in message
        movwf  msg_cnt              ;load message counter

        movlw     0x01
        movwf  tblptrh              ;load high byte of table pointer
        movlw     0x00              ;load low byte of table pointer
        movwf  tblptrl              ;tblptr = 0x0100

        movlb     bank1             ;select bank1
        clrf      ddrd              ;make portd output
        clrf      ddre              ;make porte output

        movlw     b'00000111'       ;set DL-1414 WR
        iorwf     porte
        andwf     porte             ;select DL-1414 digit 3

        movlw     0x20              ;point to message buffer
        movwf  fsr0                 ;load indirect pointer
        bcf       _fs1              ;set indirect pointer autoincrement

readme
        tablrd    0,1,wreg  ;read message
        tlrd      1,indf0           ;high byte to message buffer
        tlrd      0,indf0           ;low byte to message buffer

        decfsz    msg_cnt;decrement character count
        goto      readme            ;do it again
display_it
        movlw     0x34              ;load 8-bit character count
        movwf  msg_cnt
        movlw     0x20              ;point to message buffer
        movwf  fsr0
show_me
        movlw     b'11111111'       ;address digit3
        iorwf     porte             ;mask porte with wreg value
        movpf     indf0,portd       ;load character to portd
        call      write_it  ;write digit3

        movlw     b'11111110'       ;address digit2
        andwf     porte
```

use wreg for holding or collecting results of logical operations.

Most PIC17C42 instructions that work with wreg permit the result of an operation to be placed in the destination file register or the wreg. This comes in handy when doing register comparisons or arithmetic when you must preserve the original file-register value.

At the end of unbanked space are the TMR0 least-significant and most-significant bytes at 0x0B and 0x0C, respectively, along with the two bytes that make up the Table Pointer TBLPTR used in file-register/program-memory transfers, TBLPTRL and TBLPTRH, at 0x0D and 0x0E. The last register in the unbanked data area is BSR, at 0x0F.

Bank0 location 0x10 houses PORTA, which is six bits long, with Bits 0, 1, 4 and 5 pulling dual duty. Bit 7 of is an active-low control bit

```
        movpf   indf0,portd     ;load character to portd
        call    write_it ;write digit2

        movlw   b'11111101'     ;address digit1
        iorwf   porte           ;mask porte with wreg value
        andwf   porte
        movpf   indf0,portd     ;load character to portd
        call    write_it ;write digit1

        movlw   b'11111100'     ;address digit0
        andwf   porte
        movpf   indf0,portd     ;load character to portd
        call    write_it ;write digit0

        decf    fsr0            ;set pointer for next character
        decf    fsr0            ;in a window of 4 characters
        decf    fsr0

        movlw   0x01            ;this value determines scroll
        movwf   temp1           ;speed
wait_here
        call    dly             ;delay
        decfsz  temp1
        goto    wait_here

        decfsz  msg_cnt         ;decrement the character count

        goto    show_me         ;go get next set of characters

        goto    begin           ;go start over

;******** WRITE CHARACTER SUBROUTINE
;
write_it
        movlw   b'11111011'     ;take DL-1414 WR low
        andwf   porte
        nop                     ;allow WR time of 1uS
        movlw   b'00000100'     ;take DL-1414 WR high
        iorwf   porte
        return

;******** STANDARD DELAY SUBROUTINE
;
dly
        movlw   0xFF            ;kill time
        movwf   temp            ;loop in a loop
dly1
        movlw   0xFF
dly2
        decfsz  wreg
        goto    dly2
        decfsz  temp
        goto    dly1
        return


        org     0x0100          ;message starts at 0x0100

message
        DATA    "  MICROCOMPUTER JOURNAL EDTP PIC17C42 PROGRAMMER  "
        END
```

for PORTB, PUEB. When Bit 7 is 0, weak pull-ups are enabled on the PORTB pins.

RA0 and RA1 are Schmitt-trigger input-only pins, with RA0 performing the alternate function of external INT input and RA1 doubling as the T0CKI external interrupt input or external clock input for the TMR0 module. Use of RA0 and RA1 is determined by control bits in the RTCSTA (TMR0 status/control) register.

RA2 and RA3 are open-drain Schmitt-trigger I/O output pins. When a pull-up resistor is used with the open-drain outputs, these pins can sink greater currents and withstand greater voltages than the other I/O pins of the PIC17C42.

RA4 and RA5 are also Schmitt-trigger inputs, with RA4 becoming the RX (Receive Data) pin in asynchronous mode and the DT (Data I/O) pin in

(Continued on page 101)

By Tom Benford

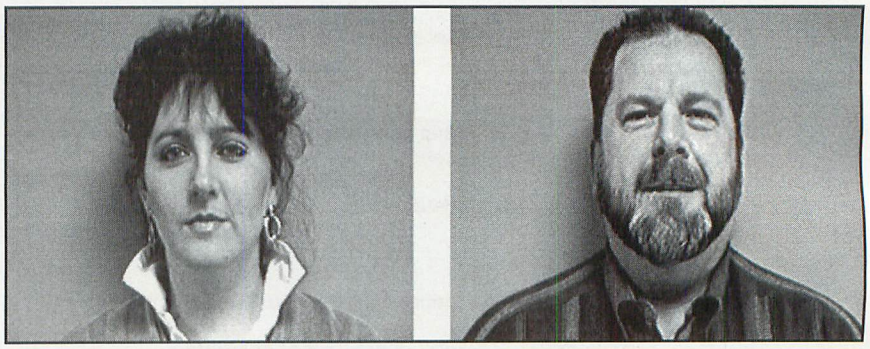
Morphing Demystified

Eye-popping Hollywood special effects are fun and easy to generate on your PC...*if* your system has enough muscle

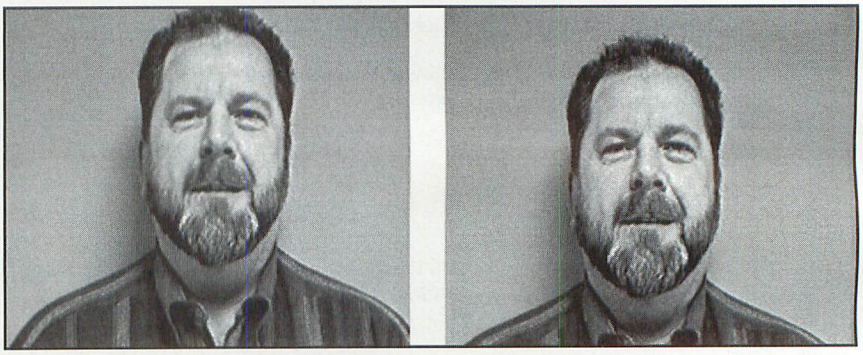
Morphing is all around us. It's currently one of the hottest and most-used special effects on the silver screen and TV. If you've seen movies like *The Abyss* and *Terminator 2*, you remember the "water figure" and the fluid-chrome baddie in them. These are two prime examples of morphing, as are Odo's remarkable transitions as the resident shape-shifter on *Star Trek: Deep Space Nine*. And Madison Avenue ad agencies were quick to jump on the morphing bandwagon, with shaving commercials in which the actor's head starts out as a cube and then constantly changes while he shaves, the pizza-chain commercials with cheese that stretches for infinity and numerous other examples.

Until recently, such impressive morphing effects were limited to big budgets and high-powered mainframe computers at Hollywood special-effects houses. Now, thanks to the power and speed of 486DX2 and Pentium-based personal computers, morphing is something you can do right on your desktop.

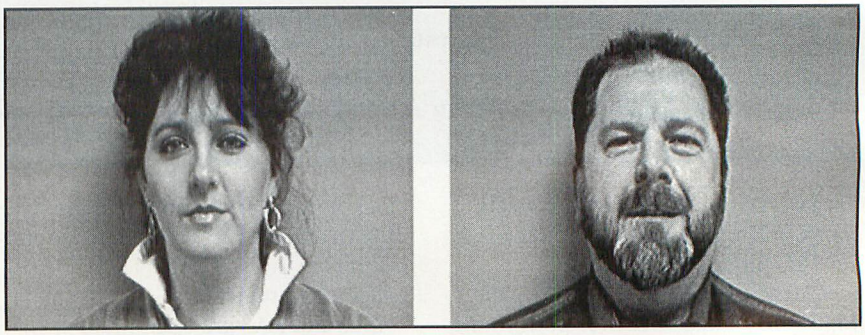
Essentially, morphing is the process of causing one image to take on the shape or form of another with a smooth transition and flow. (In fact, the term morphing derives from the Greek *morph*, which means form or shape.) While morphing is a fantastic capability to have, the software products I've used and cover here do quite a bit more than mere morphing. Such other effects as warping, generating caricatures, chroma-keying and even producing animation flip-books are all possible with some of these packages.



These images were captured using a ComputerEyes RT card and camcorder. Crucial points for compatibility in morphing two faces are eyes, nose and mouth areas. Because these points are higher on the right than on the left image, some adjustment is required to obtain optimal morphing.



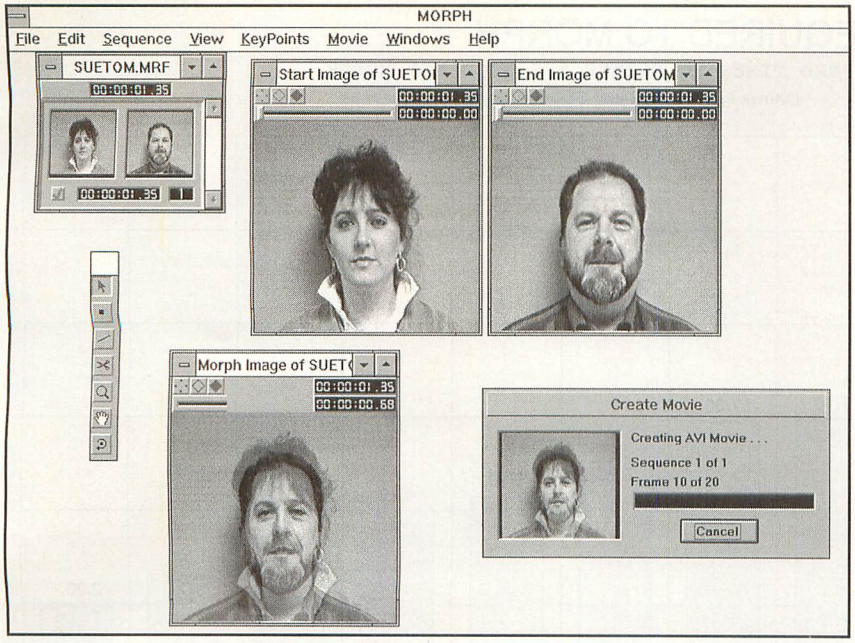
Some cropping was performed using *PC Paintbrush for Windows* to trim some of the shirt area and lower the overall image. The wall area behind the top of the head was cloned to replace the deficit caused by cropping the lower half. The image of Susan was kept in a separate window and used as a reference for alignment while cropping.



The original starting image of Susan is shown next to the adjusted ending image, which is now compatible in overall size and placement of key facial areas. These two images are now ready for morphing.

Morphing Process

Selecting images to be morphed is the first order of business. All packages covered here offer excellent flexibility



The morphing process is shown in progress here. Note that no key points have been defined, aside from good placement of the starting and ending images in conjunction with each other. The intermediate image halfway through the process shows the lap-dissolve effect produced when no key points are defined.

In this frame-by-frame dissolve morph, the starting and ending images were captured bitmap files, while the 18 frames between them are entirely computer-generated. Careful placement of the images with respect to positioning of the eyes, noses and mouths is crucial in achieving a pleasing transition. The plain background enhances the effect.

in the image formats they support, with .PCX, .TIF, .BMP, .DIB, .WMF and several others typically among available choices. For each morphing sequence, you need a starting image and an ending image. These are the two points from which the morph will be generated.

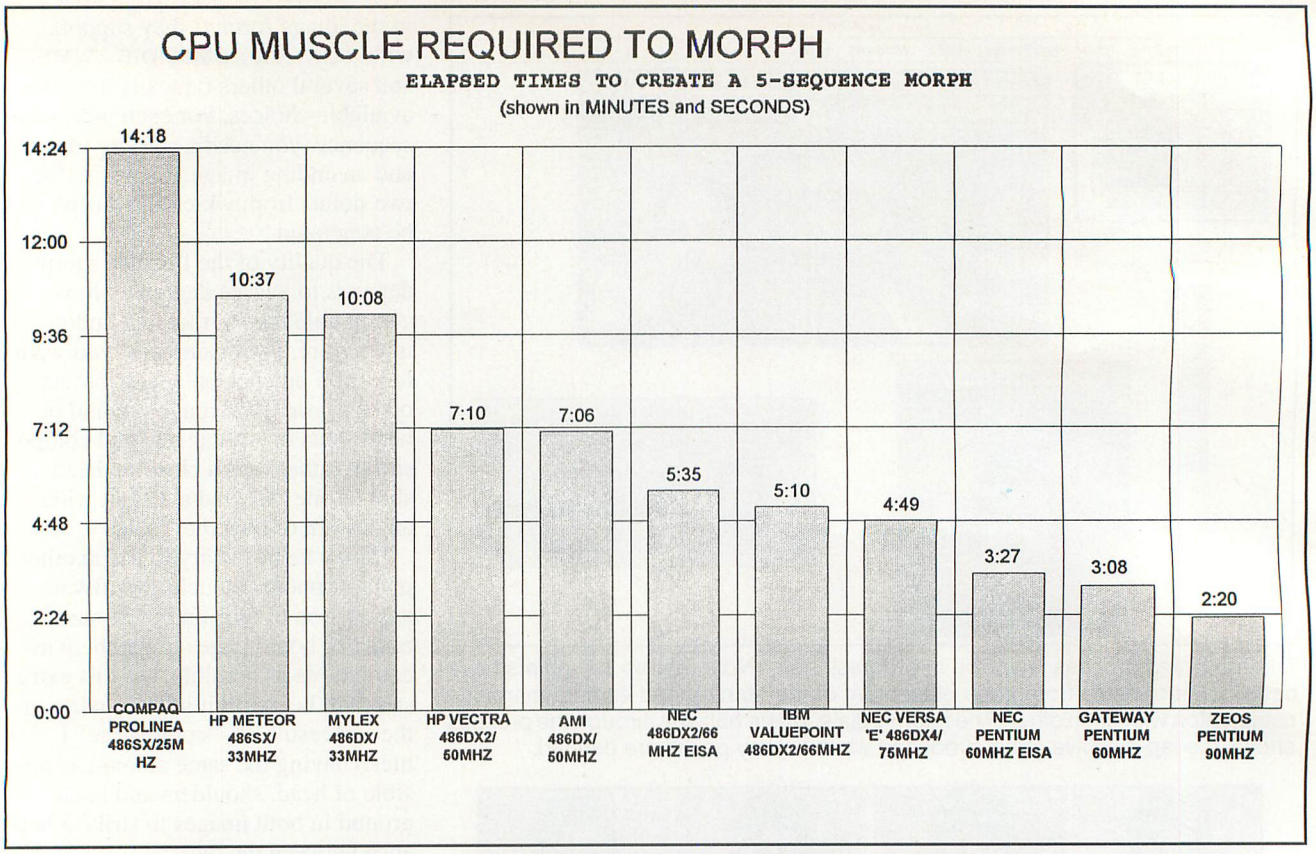
The quality of the finished morph depends to a large degree on how compatible the starting and ending images are. For example, if you want to morph one person's face into another's, your two images should be head shots of similar size and composition, rather than a close-up head shot of one face and a distant wide-angle shot of the other face.

It may be necessary to use another paint or photo-retouching software application to crop and/or re-size either or both images to get them as compatible as possible, but this extra step will be worth it in the quality of the end result. By "compatible" I mean having the same amount as possible of head, shoulders and background in both images to strike a balance between the two.

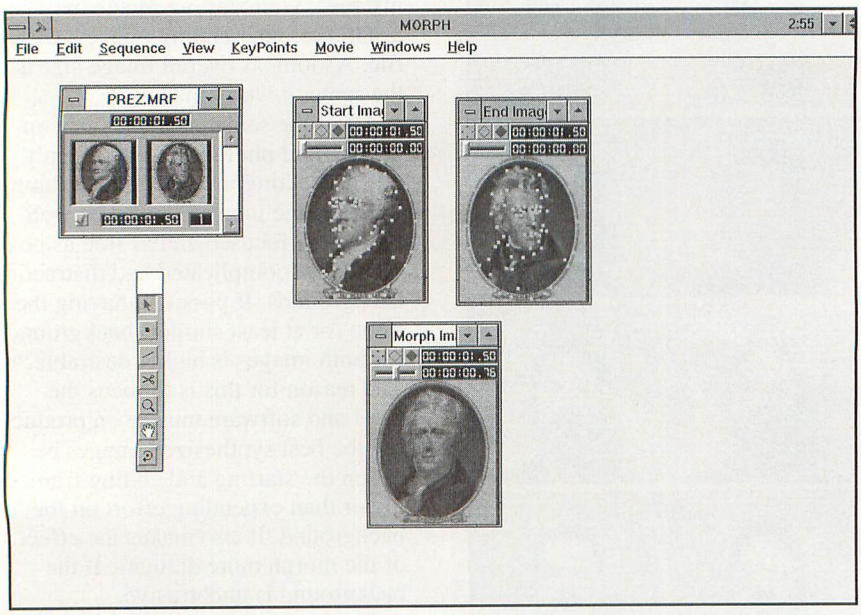
For images, you can use scanned photographs, drawn illustrations or images obtained with a video-capture card. You also have some flexibility with regard to mixing formats. For instance, your starting image may be a .TIF file, your ending image a .BMP file. As long as overall image size is the same, it won't matter.

All of the same principles that apply to good photography also apply when selecting images for morphing. Your source images should be well-lit, clearly focused and as free as possible from complicated and distracting backgrounds. If possible, having the same (or at least similar) background for both images is highly desirable. The reason for this is to focus the CPU and software muscle on producing the best synthesized images between the starting and ending frames, rather than expending effort on the background. It also makes the effect of the morph more dramatic if the background is unobtrusive.

The next step is to define the key points in the starting and ending images. These are areas that identify how the images correspond to each other. An example of this are the eyes, nose and mouth areas when morphing together two faces. By de-



Morphing is a time-consuming operation that benefits greatly from lots of CPU muscle. This chart shows the elapsed time required to morph a total of 110 frames on various PC platforms, all using the same source images and frame settings. To keep the comparison "level," all test systems were equipped with 8M of RAM running *Windows* 3.11; Gryphon's *Morph 2.5* was used as the application software for this benchmark series.



Key points (dots) are first defined on the starting image and then adjusted to the desired corresponding areas on the ending image. The greater the number of key points defined, the tighter and more dramatic the resulting morph. The midpoint morph is shown without the key point definitions to illustrate how facial features and position of the head are conforming to the pre-defined paths set by the key points.

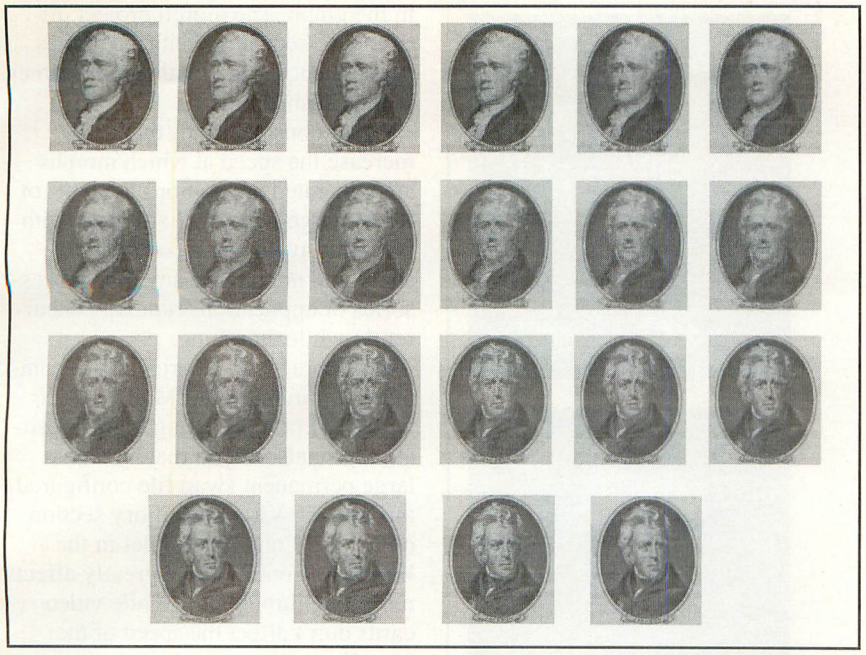
fining key points it's possible to vary the effect of the morph from loosely-defined to highly-focused.

If no key points are defined, the two images just gradually blend together through a fade-in/fade-out transition. (In the film and video world, this kind of transition is known as a lap-dissolve, since the two images dissolve into each other.)

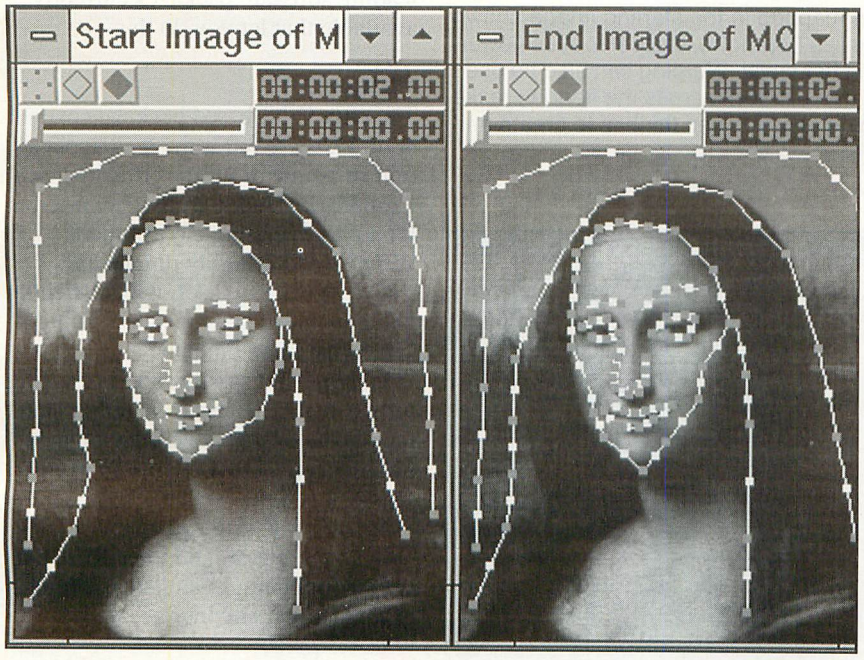
Dissolve morphs are excellent for producing smooth transitions in desktop video productions from one scene to another. They're also quite useful for gradually introducing type or other graphic elements into an image scene.

Defining specific key points lets you effect changes between the images on selected areas that, in turn, produce the most dramatic effects. In addition to making morphs between similar images more dynamic, defining key points also makes it possible to morph items with dissimilar shapes, such as a triangle and a circle or square.

One of the best examples of tight



The quality and number of frames can be set as desired for each morph. In this example, there are 22 frames from beginning to end, with the computer generating the 20 between starting and ending images, illustrating the dramatic results achieveable by defining the key points across the two images.



The image of Mona Lisa is mapped with key points to select the areas to be warped. By moving the key points in the ending image to the desired locations, the chosen areas will move to conform to the altered point positions. In this example, Mona's eyebrows are being setup to raise while here cheeks and lips are being prepped to blow a kiss.

morphing using key-point definition is shown in the illustration in which Hamilton is facing left and Jackson is facing right. Using key points to map and define corresponding facial areas, the resulting morph actually shows the head turning from left to right as the transition takes place.

Warping is another great effect supported by morph software packages. It lets you animate otherwise static images by distorting desired elements or areas of the images to alter their appearance.

Key points are again used to map selected areas, and changing their position for each deviation from the original causes the resulting computer-generated images to reflect these diverted paths. Using the image of a fish, for example, you can warp the mouth areas to simulate the lip movements of speech. You can then dub in any words or phrases you desire as the audio track for the animation and —*voilá!*—you have a talking fish.

Muscle to Morph

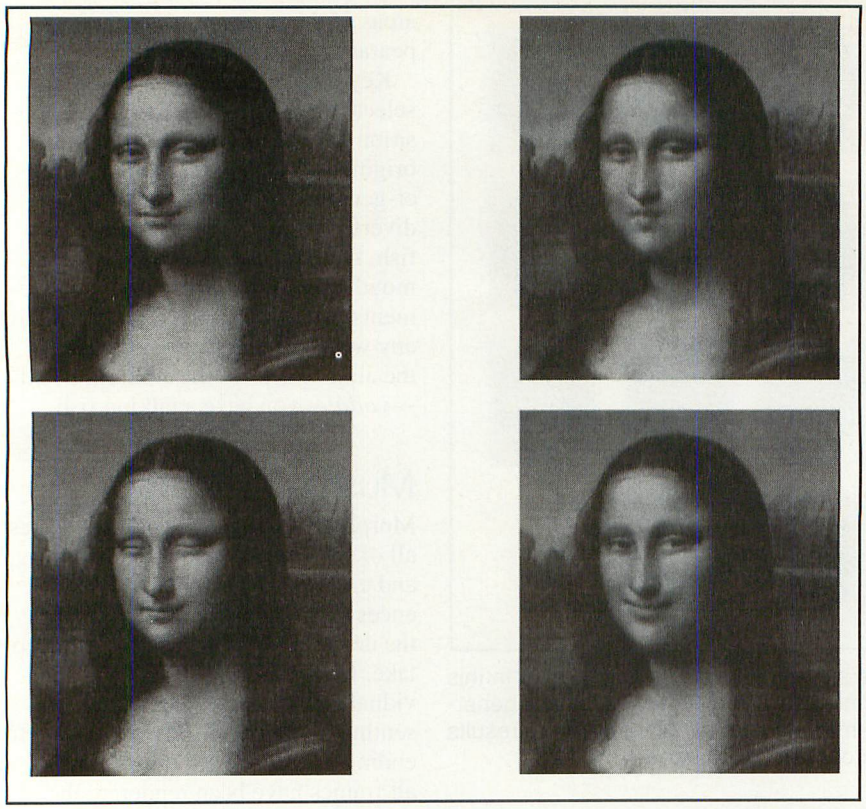
Morphing software essentially creates all of the images between the starting and ending images, using the references of the key points as a map of the desired order for the transitions to take. In this process, a series of individual frames is created, each representing a gradual shift from starting to ending image along the way. When all frames have been rendered, the software assembles the completed frames into an animated sequence that can be shown using the *Windows* Media Player accessory.

In addition to the standard *Video for Windows* .AVI (audio video interleaved), some morphing software packages let you create *AutoDesk Animator* .FLC and/or *QuickTime for Windows* video sequences.

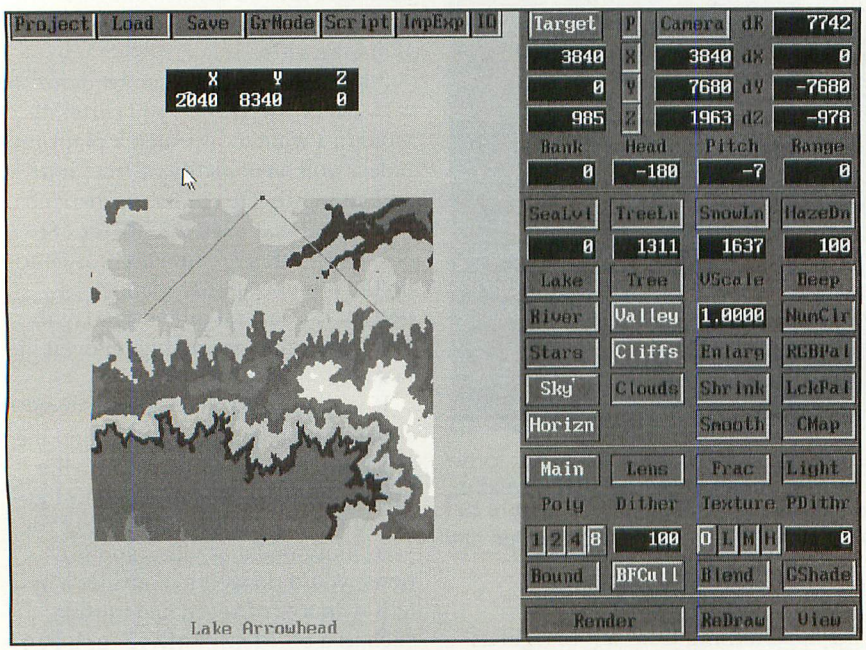
Although morphing can be done on a 16-MHz 386SX PC, you certainly wouldn't want to use such a platform unless you have plenty of free time and an inordinate amount of patience. I've found that even a 25-MHz 486-SX doesn't deliver enough muscle to do the job in a speedy manner, although it's several orders of magnitude better than morphing on even the fastest 386-based system.

If you're going to do just an occasional morph and you don't mind the wait, any 486-based PC will do the job. However, if you think you're going to be doing a lot of morphing for your multimedia or video applications, you'd do well to consider a system with lots of speed and muscle, such as a 66-MHz 486DX2- or a Pentium-based PC.

To illustrate the ratio of PC muscle to the time required for morphing, I ran a series of benchmarks on 11 different systems. The results are given



Manipulating the position of the key points mapped in the starting image shown at the top left permits you to pucker Mona's lips (top-right), close her eyes (lower-left) and raise an eyebrow while broadening her smile. Warping can also be used with inanimate objects, such as a chair, to make it "run" across the floor, to make letters in a word dance or just about anything else you can think of to create animation effects.



Vistapro 3.0 is DOS-based and designed specifically for creating virtual-reality landscapes. With its companion applications, also included on the CD-ROM, you can create fly-bys and use the morphing module to make transitions from one landscape to another. Though the program is incredibly powerful, it has a rather steep learning curve, and its interface is definitely not intuitive.

in the graph. The morph project utilized five sequences with 22 frames per sequence, for a total of 110 frames in the finished morph.

Other considerations that help increase the speed at which morphs are generated are copious amounts of RAM, large-capacity hard disks with plenty of available unfragmented space and not having any other accessories or applications running concurrently while morphing.

From practical experience, I recommend a minimum of 8M of RAM, with 16M or more being highly desirable. I've also found that having a large permanent swap file configured through the Virtual Memory section of the 386 Enhanced applet in the *Windows* Control Panel greatly affects morphing throughput. While video cards don't affect the speed of the morphing process itself, they do enhance the smoothness of the morphed sequence on playback.

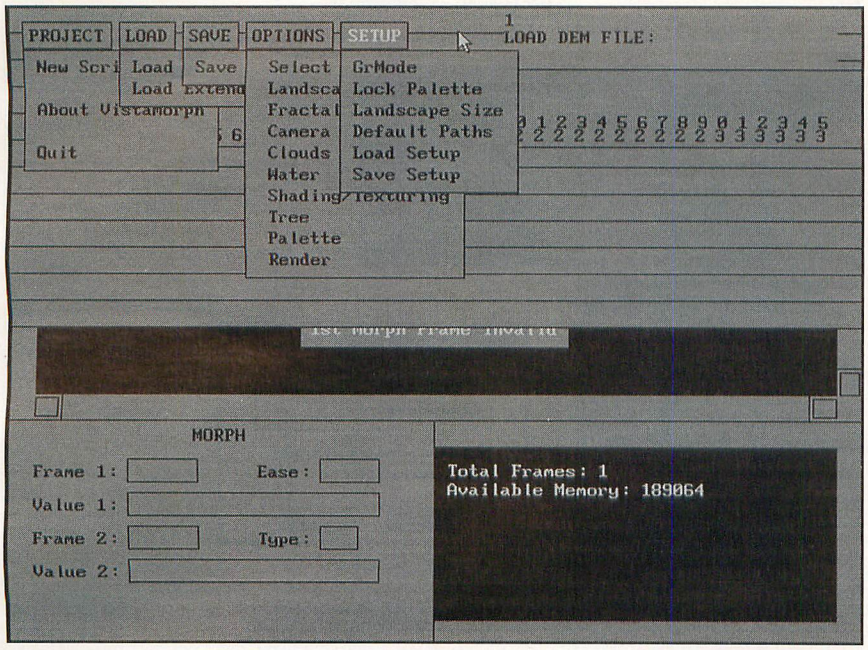
Now that you've been primed on morphing, here's a look at four of the leading software packages currently available that let you do this.

Vistapro 3.0

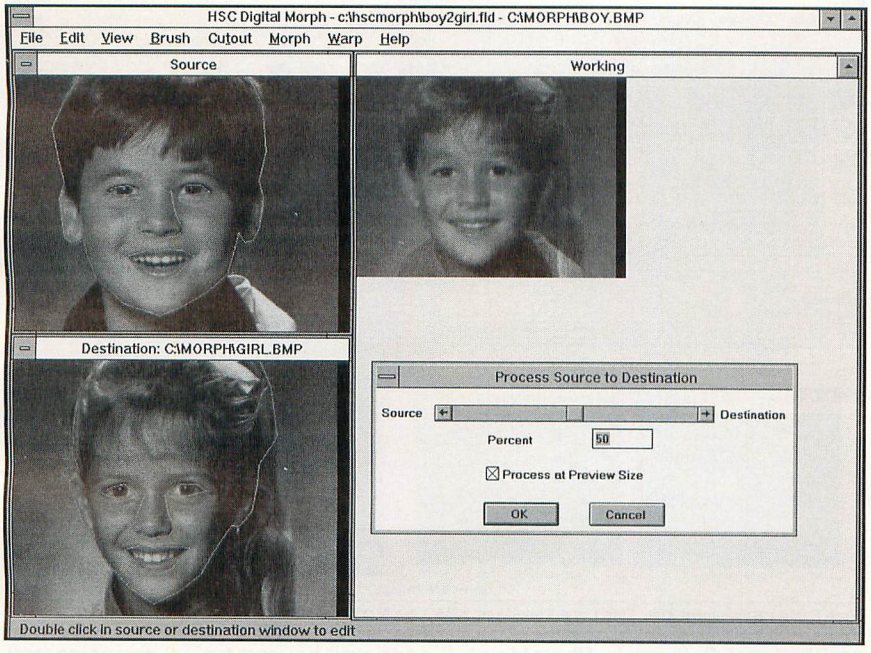
The only DOS-based package covered here, *Vistapro* 3.0 is the lead application in a suite of utilities that includes *VistaMorph*. Aside from its non-*Windows* operating environment, *Vistapro* 3.0 is highly unique and truly in a class by itself. Hence it's being included here despite it being somewhat of an oddball.

Vistapro 3.0's main forte is creating virtual-reality landscapes, rather than faces, cars or other everyday objects. Supplied on CD-ROM, the suite consists of *Vistapro*, MakePath Flight Director, *VistaMorph* and an extraordinary collection of landscape files, music for sound tracks and an assortment of images and animations created with *Vistapro*.

Vistapro uses real-world data from the U.S. Geological Survey and NASA spacecraft as the basis for its three-dimensional landscape simulations, which enable accurate recreations and explorations of landscapes on Earth and Mars in 24-bit color. The program uses fractal texturing to create rock surfaces and other topological features with amazing reality. You can also generate left and right images for 3D stereo viewing, if desired.



VistaMorph suffers from the same lack of intuitiveness that plagues *Vistapro*. While the transition parameters it provides are rich and robust, including infinite camera and lighting variations, learning to use the program to full advantage takes a considerable amount of time, and the program doesn't deliver the almost-instant gratification of *Windows*-based morphing packages.



HSC's *Digital Morph* was the first *Windows* morphing package available and continues to be one of the most powerful and popular. Field lines, which connect the dots of key points, are used to define the desired primary transition areas for morphing. These field lines are defined and visible in the starting (boy) image as well as in the ending (girl) image. The morph at the 50% completion point is also shown at the upper-right.

Once you've created a landscape, you can use *VistaMorph* to automate creation of *Vistapro* animations. This module is extremely useful for creating smooth transitions from one landscape to another or from one *Vistapro* setting (for example, tree height, snow line, sun position, etc.) to another. Some examples where *VistaMorph* comes into play are changing a scene from winter to spring, making clouds move through the sky, growing a forest, changing the lighting from daylight to dusk with lengthening shadows and a sky that changes from blue to red as a landscape scene moves toward sunset.

The resulting animations *Vistapro*/*VistaMorph* produce are either .FLI or .FLC format files that can be played using either of the two animation players provided with the software. You can also play these animations with the AutoDesk Animation Player utility from *Windows*, which comes with many other *Windows*-based multimedia products that use AutoDesk-format animations.

The program has its drawbacks. For example, it's DOS-based, making it incompatible with other *Windows*-based products. While good for a DOS-based product, the interface is cumbersome and non-intuitive when compared to *Windows* applications. The source image file formats are limited to .PCX, Targa 24, BMP24 or its own stereo-format files, and output animations are limited to .FLI or .FLC format.

If you want to create virtual-reality landscapes and breathtaking fly-bys and walk-throughs, this is definitely the best product with which to do it. If you're interested in doing more-conventional types of morphing work, however, you'll do better with any of the packages described below.

Digital Morph

HSC's *Digital Morph* was the first *Windows*-based morphing package available. It continues to be a strong seller due to its excellent assortment of features and capabilities.

Employing all of the familiar conventions of *Windows*, using the package is fairly straightforward and permits you to get off to a flying start almost immediately via a five-page quick-start tutorial, utilizing image files included with the software.

The package is capable of producing morphs and warps. Either transition effect is accomplished by delineating the desired image areas with field lines. The field lines are merely "connect the dots" of areas defined by selecting key points with your mouse. These areas correspond on the starting and ending images to provide the software with the basis of the transition.

For example, the field lines of the starting (boy's face) image in the illustration shown elsewhere in this article outline his head, eyes, mouth and nose areas. The corresponding areas of the ending image (girl's face) are also mapped. Using this pre-defined "path," the morph will affect these facial features as the primary transition areas.

The program is very flexible in image format that can be used for morphing or warping, since it supports .TGA, .BMP, .PCX, .TIF, .GIF, .JPG and compressed image types. Output filetype can be either .AVI or .FLC for animations, or each frame of the animation can be saved as a separate bitmap file.

In addition to *Digital Morph*'s abilities to morph and warp, its strongest suit is the additional image modification and manipulation options it provides. These include selections found under the Brush and Cutout menus.

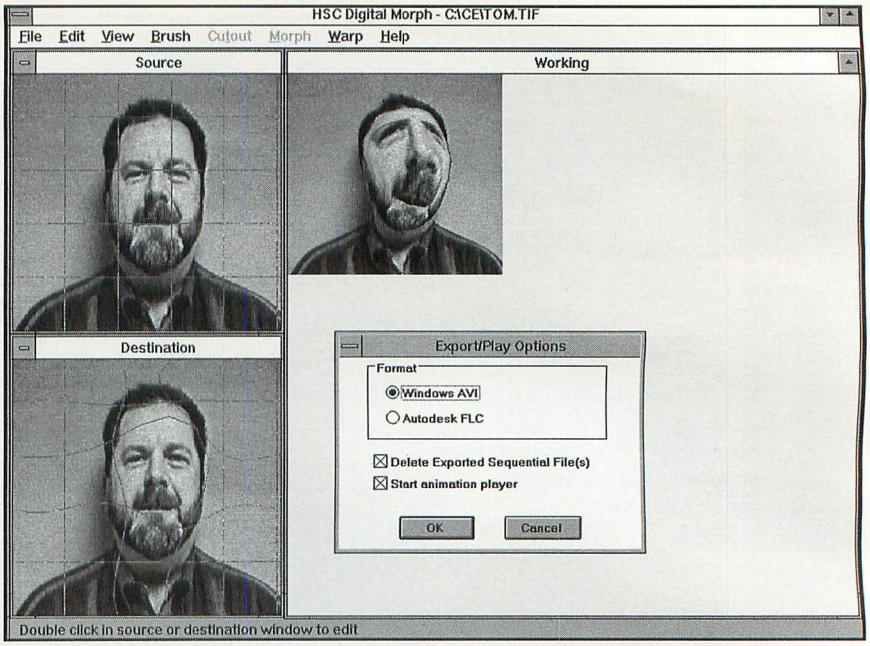
The Brush menu selections include Area, Blend, Color, Pull, Tint, Undo, Brush Color, Brush Density, Brush Pattern and Tint Color. All of these items perform the functions their names imply, and using them is as easy as using these corresponding tools in any of the popular paint or photo-retouching packages available for *Windows*. These tools permit you to optimize images to be morphed or warped from directly within *Digital Morph* without having to use an external stand-alone package to modify your images.

The Cutout menu is a really nice feature that permits you to make cutouts of selected areas of an image that can be moved, scaled, rotated, flipped and animated by themselves. You can save cutouts as a file or copy them to and from the *Windows* clipboard, which makes using this feature very flexible. Only one cutout at a time, however, can be defined and operated upon.

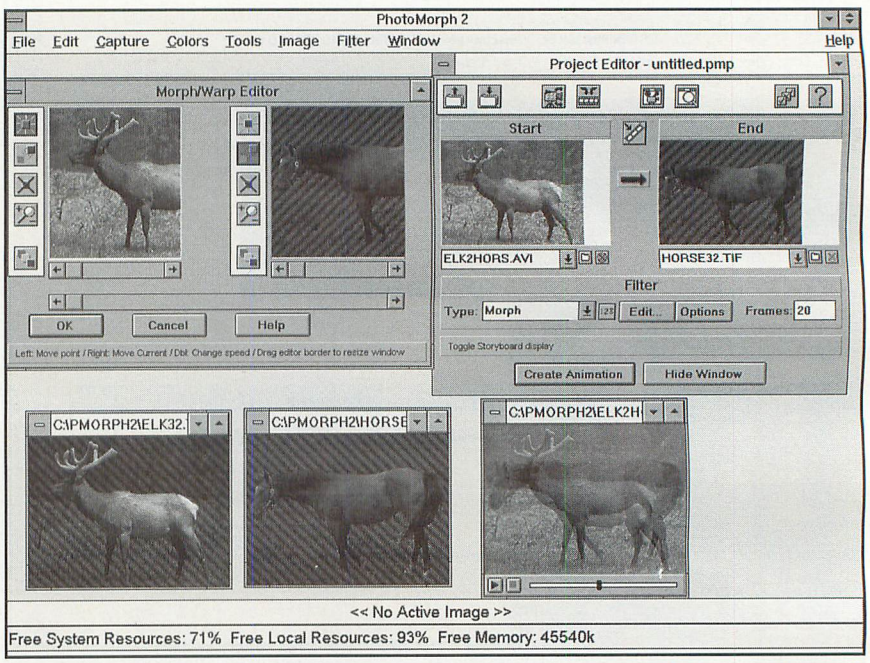
Digital Morph uses an operator called Curve Fitting, which can be enabled from the File/Preferences menu. This operator permits you to follow areas of an image by defining a series of points. Cutouts respect the current curve-fitting setting, which means that if it's disabled, the cutout shape retains the same shape as was entered. If curve fitting is enabled, the cutout area curves through the points entered, blending and arcing gracefully around the last and first points entered, to form a smoothly flowing closed shape.

Use of curve fitting is somewhat of an art that requires a bit of practice. I found that using the Zoom In option in the View menu to enlarge the image as much as possible made defining the points for curve-fitting much easier and exact. You also get much better results if you enter only points

(Continued on page 109)



Warping effects are easy to accomplish via the overlay grid with *Digital Morph*. By moving the grid points, you distort the image area beneath a given point, and feedback is immediate. As with morphing output, you have the same choices of either *Windows* .AVI or AutoDesk .FLC filetypes for the completed warping animations.



North Coast Software's *PhotoMorph* 2 goes well beyond typical morphing and warping capabilities by delivering a comprehensive suite of image-editing tools, more than 250,000 transition combinations and such special effects as blue-screening, chroma keying, colorizing and tinting. The user interface is very intuitive and easy to use, with automatic prompting for valid tool choices shown at the bottom of the screen as you position the mouse over each.

By Jan Axelson

Temperature Monitoring With a Synchronous Serial Link

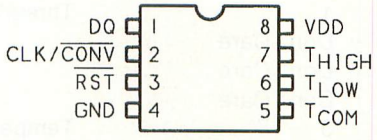
Using Dallas' DS1620 programmable chip to measure temperature an easier way

Most PCs come with serial and parallel ports for communicating with modems, printers and other devices. One interface that differs from the conventional serial and parallel link is a synchronous serial link. In this type of link, data is sent in serial form, one bit at a time, along with a common clock signal that determines when to send and read each data bit.

A synchronous serial link requires fewer wires than a parallel link. It can be faster than the asynchronous interface used by most RS-232 serial ports because you don't have to send start and stop bits with each byte. And instead of having to add a UART to translate the serial data back to parallel format, you can buy specialized chips like temperature monitors and analog-to-digital (A/D) converters that have the serial interface built into them.

Disadvantages of synchronous links include the need for an extra wire for the clock signal and sensitivity to noise, especially over longer cables. Because the receiver uses clock transitions to determine when to read each bit, a single glitch on the clock line can cause the receiver to misread an instruction or data.

In this article, I'll show you how to control a synchronous serial interface from a personal computer's parallel port or a microcontroller's I/O ports. As an example, I use Dallas Semiconductor's DS1620 digital thermometer and thermostat, which includes a Three-Wire serial interface. For those of you who have been asking how to read and write directly to a PC's ports using *Visual BASIC for Windows*, there's a section on this as well.



DS1620
DIGITAL THERMOMETER AND THERMOSTAT

PIN	SYMBOL	FUNCTION
1	DQ	3-WIRE INPUT/OUTPUT
2	CLK/$\overline{\text{CONV}}$	3-WIRE CLOCK INPUT, STANDALONE CONVERT INPUT
3	$\overline{\text{RST}}$	3-WIRE RESET INPUT
4	GND	GROUND
5	T_{COM}	HIGH/LOW COMBINATION TRIGGER
6	T_{LOW}	LOW TEMPERATURE TRIGGER
7	T_{HIGH}	HIGH TEMPERATURE TRIGGER
8	VDD	POWER SUPPLY (+5V)

Fig. 1. Pinout of DS1620 digital thermometer and thermostat.

Synchronous Links

In a synchronous link, one wire carries a clock signal that's used by both ends of the link. The transmitting end sends each bit at a defined time in the clock cycle (after a falling edge, for example). The receiving end uses the clock transitions to determine when to read the incoming bits (on the rising edge of the clock, for example).

In contrast, in an asynchronous link, both ends must agree on a clock rate, but each provides its clock independently. The receiving end monitors the line for a transition, or start bit, that indicates the beginning of a transmission. However, it uses its own clock to time when to read each bit that follows. Because the clock rates might vary slightly, each byte typically begins with a start bit to resynchronize the receiver to the transmitted data, and ends with a stop bit that indicates the end of transmission.

Other than the requirement for a common clock and serial transmitting of data, the specifics of synchronous serial interfaces can vary.

One standard interface is National Semiconductor's Microwire, which is compatible with many of National's A/D converters and other components. Some of National's COP microcontrollers have built-in Microwire capabilities to make it easier to program the interface. Chips from other manufacturers, including the DS1620 digital thermometer, use an interface

Table 1. DS1620 Instructions and Configuration Register

DS1620 Instructions

Bit	Name	Function
EEh	Start Convert	Begin a temperature conversion to measure and store the current temperature
22h	Stop Convert	Stop after the completing the current conversion (halts continuous conversion mode until the next Start Convert instruction)
0Ch	Write Config	Write a value to the configuration register
01h	Write TH	Write a value to the TH register
02h	Write TL	Write a value to the TL register
AAh	Read Temperature	Read the result of the last temperature conversion
ACh	Read Config	Read the configuration register
A1h		Read TH Read the TH register
A2h		Read TL Read the TL register

Configuration Register

Bit	Name	Value	Function
0	1-shot mode	0	Start Convert causes continuous conversions
		1	Start Convert causes one conversion
1	CPU use	0	CLK/CONV begins a conversion when RST is low
		1	Three-Wire mode, CLK/CONV acts as clock
2	X	Don't Care	
3	X	Don't Care	
4	X	Don't Care	
5	TLF	0	Temperature > value in TL
		1	Temperature <= value in TL
6	THF	0	Temperature < value in TH
		1	Temperature >= value in TH
7	DONE	0	Conversion in progress
		1	Conversion complete

DS1620 understands nine instructions. A configuration/status register stores information about mode of operation, temperature alarms, and conversion status.

similar to Microwire. Maxim Semiconductor also has a selection of devices that use synchronous serial interfaces.

Another option is the I²C interface developed by Philips Semiconductor that supports multiple devices communicating over the same set of wires.

Inside the DS1620

The DS1620 is an eight-pin programmable chip that can act as a thermometer or setpoint-detecting system. Shown in Fig. 1 is the pinout diagram for this chip. The chip is available directly from Dallas Semiconductor with no minimum order. Jameco is another source. Prices are $5 to $7 each in small quantities.

This chip can measure temperatures from –55° to +125° C (–67° to +257° F). No calibration is required. From 0° to +70° C, thermometer error is ±0.5°, increasing gradually to ±2° at the measuring limits. This makes the chip convenient for many applications, including heating and cooling controls, temperature alarms and basic temperature logging. The data sheet states nothing about how the chip measures temperature, except that it uses a proprietary technique.

The chip has two modes of operation: Three-Wire and stand-alone. In Three-Wire mode, a computer sends commands to start a conversion (to measure and store the current temperature), read the stored temperature from the chip, read and write high and low setpoints for the alarm outputs, set the mode of operation and read conversion and alarm status. To use Three-Wire mode, your computer needs two output bits to connect to CLK/CONV and RST on the DS1620 and one bidirectional bit to connect to DQ on the chip.

The recommended power supply is +5 volts ±10%.

The chip also has three alarm outputs. THIGH goes high when the measured temperature is greater than the value stored in the TH register. TLOW goes high when the temperature is less than the value in TL. And TCOM (combination) goes high when the temperature is greater than TH and stays high until the temperature falls below TL. This output is handy if you want to prevent the output from cycling on and off too frequently when the temperature is close to the setpoint.

You can connect the alarm outputs to port bits or interrupt inputs in your computer interface, or you can interface alarm or control circuits to them. For example, you could use the TCOM output to cause a heater to turn on at 68° F and turn off at 70° F.

Using Three-Wire mode, you can configure the chip for Stand-Alone operation. This mode is more limited, but it requires no computer interface. If RST is low and you bring low CLK/CONV, the chip will continuously measure the temperature and indicate alarms as they occur. Alternatively, you can trigger individual temperature measurements at specific times by briefly pulsing low CLK/CONV. Either

Table 2. Temperature Format For the DS1620

Temperature (°C)	Digital Output (Binary)	Digital Output (Hex)
+125	0 11111010	0FA
+25	0 00110010	032
+0.5	0 00000001	001
0	0 00000000	000
–0.5	1 11111111	1FF
–25	1 11001110	1CE
–55	1 10010010	192

°F = (9/5 * (°Celsius)) + 32

DS1620 stores temperatures in a nine-bit format, with resolution of 0.5°. Negative temperatures are stored as two's complements.

way, you can use the alarm outputs for monitoring or control functions.

To write data to the chip in Three-Wire mode, you first send an eight-bit instruction that tells the chip what type of data you're going to write. Table 1 summarizes the nine instructions that the DS1620 recognizes.

Temperature registers in the DS1620 are nine bits each and store positive and negative values, with a resolution of 0.5°. For positive tempera- tures, Bit 8 is 0, Bits 1 through 7 hold the integer value of the temperature and Bit 0, if set, adds 0.5°. Negative temperatures are similar, except that Bit 8 is 1 and the temperature is stored in two's-complement format. (To find the two's complement of a nine-bit value, subtract it from 1FFh.) Table 2 illustrates some examples of temperatures and their translations into DS1620 format.

To read or write a value to the DS-1620, you first must do the following:

(1) To begin, RST is low and CLK/CONV is high. Configure the port bit that connects to DQ as an output.

(2) Bring high RST.

(3) Bring low CLK/CONV.

(4) Set DQ equal to Bit 0 of the desired instruction.

(5) Bring high CLK/CONV.

(6) Repeat Steps 3, 4 and 5 for Bits 1 through 7 of the instruction.

To write the chip, you next perform these steps:

(7W) Repeat Steps 3, 4 and 5 for Bits 0 through 7 or 0 through 8 of the data to be written (if any).

(8W) Bring low RST for at least 5 ms.

To read a value from the DS1620, perform Steps 1 through 6 above and then perform the following steps:

(7R) Configure the port bit that connects to DQ as an input to prepare to read from DQ.

(8R) Bring low CLK/CONV. DQ is now an output that holds the data to be read.

(9R) Read and store DQ (Bit 0).

(10R) Bring high CLK/CONV.

(11R) Repeat Steps 8, 9 and 10 for Bits 1 through 7 or 1 through 8 of the data to be read.

(12R) Bring low RST.

(13R) Configure the port bit that connects to DQ as an output again.

The data sheet specifies minimum delays between each of the above steps, but most are short enough in duration (125 ns or less) that you won't have to worry about meeting the requirement in most cases. There are two exceptions. RST must remain low for at least 5 ms after you write data to the DS1620 (Step 8W). This delay gives the chip's internal EE-PROM enough time to store the data. Also, the chip needs 1 second to execute a start-convert instruction. So after performing a temperature conversion (instruction EEh), you must wait 1 second before you read the result (instruction AAh).

Unlike some serial chips, the DS-1620's CLK frequency has no minimum. Therefore, you can clock it as slowly as you want. I even ran a few tests by toggling CLK/CONV, RST and DQ with debounced manual switches with no problem (this is a very tedious way to control the chip, however). Maximum clock frequency is 4 MHz.

Using the DS1620

There are several types of interfaces you might use with the DS1620. You can connect the chip to I/O bits on a

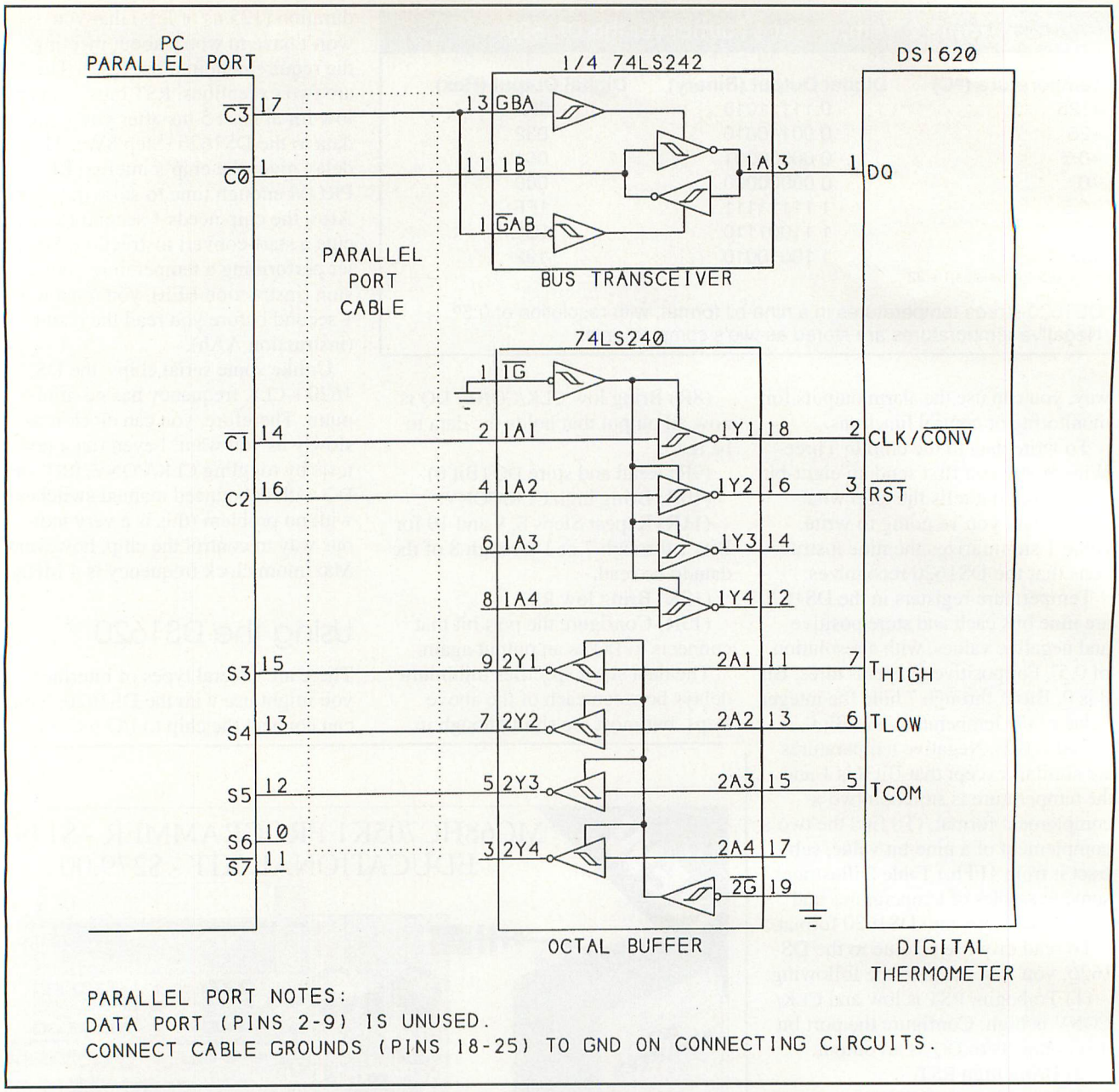


Fig. 2. This interface enables you to program, control and read DS1620 from a PC's parallel port.

microcontroller or an I/O chip like the 8255. You can communicate using the parallel port of a PC. Or you can use a programmed chip as a temperature alarm or controller with no computer interface at all.

• **Microcontroller Interface.** The microcontroller interface is the easiest from a hardware perspective. Most microcontrollers have bidirectional I/O ports and even bit control instructions so that you can toggle individual bits as needed. A microcontroller interface is handy if you want a small portable system with the ability to access all of the chip's features.

To interface to the DS1620, connect spare port bits to CLK/CONV, RST and DQ, and to THIGH, TLOW and TCOM if you want to read these. If the chip is on the same circuit board as the microcontroller, or if the connecting cable is short (1 foot or less), you can connect the chip directly to the microcontroller, with no added buffers or drivers.

If you're using an 8051-family microcontroller, remember to write a 1 to any bit you want to use as input (for example, TLOW, THIGH and TCOM, and DQ when you use it as input).

PIC microcontrollers have direction-control bits you set or clear to determine the direction of a port bit.

The DS1620 uses TTL-logic voltages, which means that logic-high outputs may be as low as 2.4 volts. Most microcontrollers, including CMOS ones, have TTL-compatible inputs and outputs at their ports. So the DS1620 can connect directly. If an input does require CMOS levels, add a 10,000-ohm pull-up resistor from DQ to +5 volts to ensure that high outputs are at least 3.5 volts.

• **Parallel Port Interface.** Controlling the DS1620 from a PC's parallel port is a little more complicated, partly because the outputs of the DS1620

Listing 1. Test Program for Fig. 4 Circuit

```
BaseAddress = &H3BC:                    'base address of parallel port
                                        'change to match your port's address
StatusPort = BaseAddress + 1
ControlPort = BaseAddress + 2

'Signals that interface to DS1620:
DQ = 1:  'bit 0                         'Control port
CLK = 2: 'bit 1                         '   "
RST = 4: 'bit 2                         '   "
DIR = 8: 'bit 3                         '   "
TH = 8:  'bit 3                         'Status port
TL = &H10: 'bit 4                       '   "
TC = &H20: 'bit 5                       '   "

MainProgram:
OUT ControlPort, RST + CLK:             'Reset is on, CLK is high
DO
  SelectAction:
  PRINT "Select an action: "
  PRINT "Start convert                0"
  PRINT "Stop convert                 1"
  PRINT "Write to config register     2"
  PRINT "Store high setpoint          3"
  PRINT "Store low setpoint           4"
  PRINT "Read config register         5"
  PRINT "Read Temperature             6"
  PRINT "Read high setpoint           7"
  PRINT "Read low setpoint            8"
  PRINT "Wait for alarms              9"
  PRINT "Quit                        10"
  INPUT Action

  OUT ControlPort, CLK:                 'Remove Reset, keep CLK high

  SELECT CASE Action
    CASE 0
      GOSUB StartConvert
    CASE 1
      GOSUB StopConvert
    CASE 2
      GOSUB WriteConfig
    CASE 3
      GOSUB WriteTH
    CASE 4
      GOSUB WriteTL
    CASE 5
      GOSUB ReadConfig
    CASE 6
      GOSUB ReadTemp
    CASE 7
```

→

aren't intended for driving the typical 10-foot parallel cable and partly because the parallel-port interface itself can be a little tricky. For example, some of the port's status and control bits are inverted internally, while others aren't. You have to keep track of things like this when you program the port. (See my article in the May/June 1994 issue of *MicroComputer Journal* for more details on the parallel port.)

You can use the parallel-port interface in two ways. You might have an application in which you measure temperatures or monitor for alarms directly at the parallel port. If you have a laptop or notebook computer, you can run the program just about anywhere. You can easily disconnect the DS1620 when you want to use the parallel port for something else.

Another use for the parallel port is as a convenient way to program the chip for Stand-Alone mode. You can store the setpoints you want, set mode of operation and configure the chip for Stand-Alone operation. You then

```
      GOSUB ReadTH
    CASE 8
      GOSUB ReadTL
    CASE 9
      GOSUB WaitForAlarms
    CASE 10
      GOTO Done
    CASE ELSE
      GOTO SelectAction
    END SELECT
LOOP WHILE 1 = 1

Done:
OUT ControlPort, RST + CLK:          'Reset chip when done
END

StartConvert:
  Instruction = &HEE
  GOSUB WriteAnInstruction
  RETURN

StopConvert:
  Instruction = &H22
  GOSUB WriteAnInstruction
  RETURN

WriteConfig:
  INPUT "Value to write to config register? ", DataToWrite
  Instruction = &HC
  GOSUB WriteAnInstruction
  GOSUB WriteData
  RETURN

WriteTH:
  INPUT "Setpoint in degrees Celsius ?", DataToWrite
  DataToWrite = DataToWrite * 2:    'convert to format used by chip
  Instruction = &H1
  GOSUB WriteAnInstruction
  GOSUB WriteData
  RETURN

WriteTL:
INPUT "Setpoint in degrees Celsius? ", DataToWrite
  DataToWrite = DataToWrite * 2:    'convert to format used by chip
  Instruction = 2
  GOSUB WriteAnInstruction
  GOSUB WriteData
  RETURN

ReadConfig:
  Instruction = &HAC
```

can use the chip to monitor temperatures on its own, adding alarm or control circuits as you wish.

The easy way to program the chip from the parallel port is to order Dallas Semiconductor's Starter Kit ($60), which includes a printed-circuit board with a DS1620, parallel-port interface and DOS and *Windows* software for controlling the chip.

If you'd rather do it yourself, Fig. 2 shows a circuit I've used to control the DS1620 from a parallel port. The circuit adds buffers and drivers to help ensure that the signals arrive in good shape at the far end of the cable. The circuit uses the parallel status and control lines of the parallel port to read from and write to the DS1620.

The DQ bit connects through a 74-LS242 transceiver to Bit 0 of the parallel port's control port (C0). The control port is bidirectional. Writing a 1 to a bit enables you to use it as input.

Bit C3 on the control port is a direction control for the transceiver. When DQ is an input (its usual state), C3 should be high. This causes C0 to appear in inverted form at DQ. In other words, signal flow is from pin 11 to

```
   GOSUB WriteAnInstruction
   GOSUB ReadData
   PRINT
   PRINT "Config register = ", HEX$(ReadValue)

ReadTemp:
   Instruction = &HAA
   GOSUB WriteAnInstruction
   GOSUB ReadData
   GOSUB ConvertFromChipFormat
   PRINT "Temperature = "; ReadValue; "degrees C"
   RETURN

ReadTH:
   Instruction = &HA1
   GOSUB WriteAnInstruction
   GOSUB ReadData
   GOSUB ConvertFromChipFormat
   PRINT "High setpoint = "; ReadValue; "degrees C"
   RETURN

ReadTL:
   Instruction = &HA2
   GOSUB WriteAnInstruction
   GOSUB ReadData
   GOSUB ConvertFromChipFormat
   PRINT "Low setpoint = ", ReadValue; "degrees C"
   RETURN

WriteAnInstruction: 'writes an 8-bit instruction to the DS1620's DQ input
OUT ControlPort, RST + CLK:          'toggle Reset before each write
FOR I = 1 TO 2000: NEXT I:           'wait 5 milliseconds
OUT ControlPort, CLK:                'Reset off, CLK high
FOR BitNumber = 0 TO 7
   Bit = (Instruction AND 2 ^ BitNumber) / 2 ^ BitNumber: 'see if bit = 0 o
   OUT ControlPort, 0:               'bring CLK low
   OUT ControlPort, Bit:             'set or clear DQ to match Bit
   OUT ControlPort, Bit + CLK:       'bring CLK high
NEXT BitNumber
RETURN

WriteData:
'writes data to the DS1620's DQ after a write instruction
FOR BitNumber = 0 TO 8:              'chip ignores bit 8 if unneeded
   Bit = (DataToWrite AND 2 ^ BitNumber) / 2 ^ BitNumber: 'see if bit = 0 o
   OUT ControlPort, 0:               'bring CLK low
   OUT ControlPort, Bit:             'set or clear DQ to match Bit
   OUT ControlPort, Bit + CLK:       'bring CLK high
NEXT BitNumber
RETURN
```

→

pin 3. When DQ is an output (when reading data from it), C3 should be low. This causes DQ to appear in inverted form at C0, and signal flow is from pin 3 to pin 11.

The CLK/CONV and RST inputs connect to two of the buffers in a 74LS240 octal buffer, which are driven by the two remaining bits of the control port.

The three alarm outputs each connect to a 74LS240 buffer/driver that controls a status input (S3, S4, S5) on the parallel port. Connecting these is optional.

The 74LS242 and 74LS240 have Schmitt-trigger inputs, which help to make them immune to noise. Don't forget to connect the cable grounds (pins 18 through 25) to GND at your connecting circuits.

Listing 1 is a BASIC program that tests the Fig. 2 circuits. The program follows the procedures described above for reading from and writing to the port.

All control bits, except C2, are inverted internally by the parallel-port circuits. In other words, writing a 1 to C0, C1 or C3 causes the corresponding

```
ReadData: 'reads 9 bits and combines them into a single value
ReadValue = 0: 'begin by clearing the variable
OUT ControlPort, DIR + CLK:          'change direction of transceiver
                                     'C0 must also be high to use as input
FOR BitValue = 0 TO 8:               'add each bit in turn to the total
  OUT ControlPort, DIR:              'bring CLK low; DQ is now an output
  BitRead = (INP(ControlPort) AND DQ):     'read DQ
  OUT ControlPort, CLK + DIR:        'bring CLK high
  'if DQ is high, add its value to the total; otherwise ignore it
  IF BitRead >= 1 THEN ReadValue = ReadValue + 2 ^ BitValue
NEXT BitValue
OUT ControlPort, CLK:                'bring DIR low (DQ is input again)
ReadValue = ReadValue AND &H1FF      'clear unused high bits
RETURN

ConvertFromChipFormat:
IF (ReadValue AND &H100) = &H100 THEN:   'for negative values
  ReadValue = (ReadValue - 1) XOR &H1FF: 'restore from 2's complement
  ReadValue = -(ReadValue AND &HFF):     'clear bit 8
END IF
ReadValue = ReadValue / 2:           'divide by 2 because bit 0 = 1/2
RETURN

WaitForAlarms:
'reads the status inputs repeatedly, displays message on alarm
PRINT "Waiting for alarms; press any key to stop"
DO
  GOSUB StartConvert
  Alarms = INP(StatusPort)
  IF (Alarms AND 8) = 0 THEN PRINT "High Temperature Alarm"
  IF (Alarms AND &H10) = 0 THEN PRINT "Low Temperature Alarm"
  IF (Alarms AND &H20) = 0 THEN PRINT "TC Temperature Alarm"
  FOR I = 1 TO 50000: NEXT I:        'optional delay
LOOP WHILE INKEY$ = ""
RETURN
```

pin on the parallel port to go low. But since all of the buffers and drivers are also inverters, the value you read or write at the parallel port equals the corresponding bit at the DS1620 (or the 74LS242's enable inputs, in the case of the direction-control bit).

The exception is C2. I used this bit to drive RST, which is active-low. Therefore, writing a 1 to C2 causes RST to be active.

The status bits used aren't inverted by the parallel port. Because the 74-LS240 inverts the signals, reading 0 at S3, S4 or S5 means that the corresponding output on the DS1620 is high.

If you have problems getting the interface up and running, try single-stepping through the program and monitoring the signals at each step to verify that everything is as it should be. A logic probe with a memory LED is useful for detecting glitches on the CLK and RST lines. (A single glitch on either of these can cause an entire instruction to be misread.)

The parallel cable should be no longer than 15 feet, though 10 feet is better. Any longer than this, and you can start to have problems with noise or signal degrading.

If you want to measure temperatures over a longer distance, a better solution might be to use an RS-232 serial port and a different set of components. You'll need more hardware at the temperature-sensing end, but the RS-232 link requires just three wires and can go 100 feet or more, especially at slow speeds. At the far end of the link, you need a UART, an A/D converter and a temperature sensor, such as the LM34. (See my articles in the November/December 1994 and January/February 1995 issues of *MicroComputer Journal* for more on this type of serial interfacing.)

Stand-Alone Mode

Shown in Fig. 3 are the details for the DS1620 in Stand-Alone mode. It also shows circuits you can connect to the alarm outputs in Stand-Alone or Three-Wire mode. Before you can use this circuit, you have to use Three-Wire mode to program the chip by setting Bit 1 in the configuration register to 0 and writing the desired values to the alarm setpoints.

For continuous temperature conversions, close the switch at pin 2. (CLK/CONV must be high on power-up.) To start a single conversion, use the alternate circuits shown instead of the

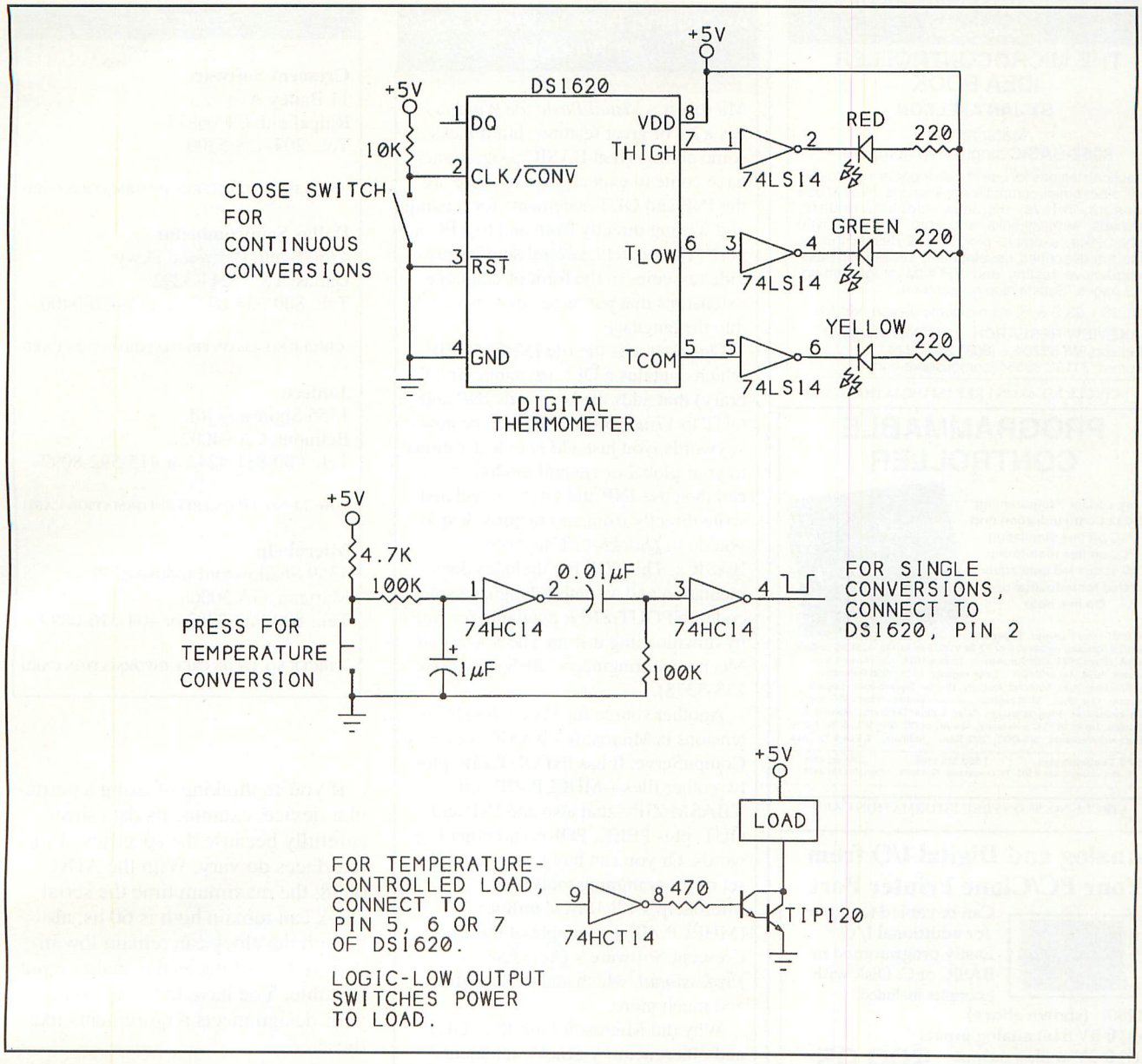


Fig. 3. In Stand-Alone mode, DS1620 monitors temperature and output alarms.

switch and resistor at pin 2. Press the switch to cause a single pulse of about 1 ms duration at CLK/CONV.

The DS1620's alarm outputs can source just 1 mA at 2.4 volts and sink 4 mA at 0.4 volt. So most alarm interfaces will require some buffering.

Shown in Fig. 3 are LEDs connected to the alarm outputs. This circuit is convenient for testing. The red LED lights when the temperature exceeds TH, the green LED when the temperature is less than TL and the yellow LED when the red LED does and stays on until the green LED lights. If you use HCMOS inverters in place of the 74LS14s, add a 10,000-ohm pull-up resistor from each alarm output to +5 volts.

Also shown in Fig. 3 is a circuit that powers a load when an alarm output is low. You can use any HCTMOS inverter or inverting gate. If you use an HCMOS device, add a pull-up resistor to its input. To power a load when the alarm output is high, use a noninverting buffer or gate. Possible uses might be a fan that runs when T_{COM} is high or a heater that runs when T_{COM} is low.

You can use any npn transistor with an appropriate power rating for your load. The load's power supply can be greater than 5 volts. You can also use buffers or inverters to control electromechanical or solid-state relays.

Other Serial Chips

The DS1620 isn't the only chip that uses a synchronous serial interface. National Semiconductor's ADC0838 is a serial eight-channel A/D converter, and the DAC0854 is a serial quad A/D converter.

Accessing Ports In *Visual Basic for Windows*

Microsoft's *Visual Basic for Windows* has a lot of great features, but it lacks some abilities that BASIC programmers have come to expect. Two of these are the INP and OUT statements for reading and writing directly from and to a PC's ports. Fortunately, several sources provide remedies in the form of language extensions that put these keywords back into the language.

One source is the file INPOUT.ZIP, which contains a DLL (dynamic link library) that adds the keywords INP and OUT to *Visual BASIC*. To use the new keywords, you just add two declarations to your global or general module. You can then use INP and OUT to read and write directly from and to ports, just as you do in *QuickBASIC* and other BASICs. This .ZIP file includes documentation and assembly-language source code. INPOUT.ZIP is available for free by downloading it from The Society of Mechanical Engineers' BBS (tel.: 608-233-3378).

Another source for *Visual-BASIC* extensions is Microsoft's BASIC forum on CompuServe. It has INPOUT.ZIP, plus two other files—MHELP.ZIP and VBASM.ZIP—that also add INP and OUT, plus PEEK, POKE and other keywords. Or you can buy a more-complete set of programming tools like Microhelp's *VB Muscle* utilities (MHELP.ZIP is a sample of these) or Crescent Software's *QuickPak Professional*, which add these abilities and much more.

Why did Microsoft omit INP, OUT and other memory-access statements from *Visual BASIC*? I can only speculate, but I think it has to do with a reluctance to let BASIC programmers have direct control over specific locations in memory, especially in an environment like *Windows* in which multiple programs may be running and accessing the hardware. Obviously, if two programs attempt to do different things with the parallel port at the same time, you're going to have problems. But since *Visual BASIC* provides no other way to access the parallel port's registers, additions like INP and OUT seem to be the only solution. As long as no other programs attempt to use the port, there should be no problems.

One caution: the INP and OUT statements work fine in *Windows* 3.1, but there are no guarantees if you use a later version, such as *Windows 95*.

Sources

Crescent Software
11 Bailey Ave.
Ridgefield, CT 06877
Tel.: 203-438-5300

CIRCLE NO. 155 ON FREE INFORMATION CARD

Dallas Semiconductor
4350 South Beltwood Pkwy.
Dallas, TX 75244-3292
Tel.: 800-336-6933 or 214-450-0400

CIRCLE NO. 156 ON FREE INFORMATION CARD

Jameco
1355 Shoreway Rd.
Belmont, CA 94002
Tel.: 800-831-4242 or 415-592-8097

CIRCLE NO. 157 ON FREE INFORMATION CARD

Microhelp
4359 Shallowford Industrial Pkwy.
Marietta, GA 30066
Tel.: 800-922-3383 or 404-516-0899

CIRCLE NO. 158 ON FREE INFORMATION CARD

If you're thinking of using a particular device, examine its data sheet carefully because the specifics of the interfaces do vary. With the ADC-0838, the maximum time the serial clock can remain high is 60 µs, although the clock can remain low indefinitely, as long as the analog input is stable. You have to be sure that your design meets requirements like these.

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Jan Axelson

By TJ Byers

CPU Upgrades: The Complete Story

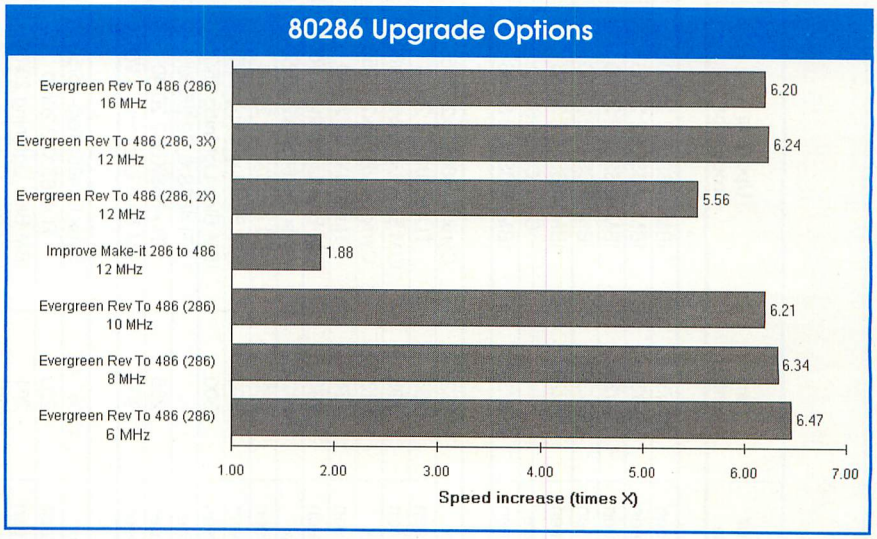
If you have a 286, 386 or 486 PC that needs a pep pill, here are CPU-upgrade options that will turn it into a 486 speedster

Are you tired of staring at the *Windows* hourglass while your PC slowly grinds its way through a large spreadsheet or drawing application? Sure, it would be nice to have a 486DX4 or Pentium PC instead of the 386 system you're now using. But if you're like many of us, you can't afford the luxury of buying a new PC. Fortunately, thanks to recent price cuts in CPU upgrades and OverDrive chips, you can turn a poky PC into a screamer without busting your piggy bank.

A low $249 will turn nearly any 286 system into a 50-MHz 486SLC equivalent. For less than $350, you can convert a 16-MHz 386SX system into a 48-MHz 486SX, and going from 25-MHz 386DX to 75-MHz 486DX2 performance costs just $450. If you really want to push the pedal to the metal, $650 can upgrade any 33-MHz 486 motherboard to a 100-MHz 486DX4.

Not only is this a great way to recycle an old 286 clone that's gathering dust in a closet (perhaps putting it to use as a starter system for the youngsters), it's also the ideal solution for companies that can't afford to purchase new systems because of the large cash outlay and lost equipment-depreciation tax credits.

So where do you find one of these gems? What do you need to know when buying a CPU upgrade? And how difficult is it to install the new part? Actually, it doesn't take any talent at all to select the upgrade that's right for your system and have it up and running within 15 minutes. You need to know a bare minimum of technical details about your system and how to use a screwdriver. Here's the inside story.



Family Portrait

Whether you have an original 6-MHz IBM PC/AT, PS/2 Model 70 or 486-DX/50, the chance of finding a CPU upgrade that's compatible with it is quite good. Upgrades come in the form of direct-replacement chips and assemblies that are sometimes called "daughterboards."

Replacement chips like the popular Intel OverDrive processor are single-chip products that plug directly into a socket that's located on the motherboard. Daughterboards are printed-circuit assemblies that are an inch or two square, each with an upgrade processor and additional circuitry. A third, now almost obsolete, upgrade method is a processor replacement card that has the CPU built onto a circuit card that plugs into a proprietary slot on the motherboard, like those found in some Compaq and ALR computers.

Upgrades span the entire range of Intel-compatible processors, from 286 to 486 and all their variations, with the promise of Pentium upgrades in the near future. Moreover, the upgrades aren't particularly "Intel inside"-sensitive. Virtually all can replace or upgrade Intel and AMD processors, with a few that are compatible with Cyrix, IBM and Texas Instruments processors as well. Sometimes, an upgrade includes a math coprocessor, and sometimes it doesn't.

Essentially, the major players that provide the bulk of the CPU upgrade products are Cyrix, Evergreen Technologies, Intel and Kingston Technology. Of these, Evergreen has the broadest coverage, with a line of products that extends from 286 systems up to the 486DX.

CPU Speed (MHz)	Upgrade Construction	Product Name	Vendor Name	Part Number	Upgrade Processor	Upgrade Speed (MHz)	Internal Cache (K)	Math Coprocessor	Price ($)
286 Upgrade Options									
6	Assembly	Rev to 486 (286, PGA)	Evergreen	294/394	IBM 486SLC2 25/50	50	16	N/Y	249/279
8	Assembly	Rev to 486 (286, PGA)	Evergreen	294/394	IBM 486SLC2 25/50	50	16	N/Y	249/279
10	Assembly	Rev to 486 (286, PGA)	Evergreen	294/394	IBM 486SLC2 25/50	50	16	N/Y	249/279
12	Assembly	Rev to 486 (286, PLCC)	Evergreen	293/393	IBM 486SLC2 25/50	50	16	N/Y	249/279
12	Assembly	Rev to 486 (286, PLCC)	Evergreen	295/295	IBM 486SLC2 33/66	66	16	N/Y	269/299
12	Assembly	Make-it 286 to 486	Improve		Cyrix Cx486SLC	33	1	N/Y	249/279
16	Assembly	Rev to 486 (286, PLCC)	Evergreen	295/395	IBM 386SLC2 33/66	66	16	N/Y	269/299
386SX Upgrade Options									
16	Chip	SRx2	Cyrix	15162-02	Cyrix Cx486SRx2-25/50	32	1	N	249
16	Chip	Rev to 486 (386SX2+)	Evergreen	288	TI 486SXLC2 20/40	32	8	N	229
16	Assembly	Rev to 486 (386SX3+)	Evergreen	298	IBM Blue Lightning 20/60	48	16	N	349
20	Chip	SRx2	Cyrix	15162-02	Cyrix Cx486SRx2 25/50	40	1	N	249
20	Chip	Rev to 486 (386SX2+)	Evergreen	288	TI 486SXLC2 20/40	40	8	N	229
20	Assembly	Rev to 486 (386SX3+)	Evergreen	298	IBM Blue Lightning 20/60	60	16	N	349
25	Chip	SRx2	Cyrix	15162-02	Cyrix Cx486SRx2-25/50	50	1	N	249
25	Chip	Rev to 486 (386SX2+)	Evergreen	288	TI 486SXLC2 20/40	25	8	N	229
25	Assembly	Rev to 486 (386SX3+)	Evergreen	298	IBM Blue Lightning 25/50	50	16	N	349
25	Assembly	Rev to 486 (386SX3+)	Evergreen	300	IBM Blue Lightning 25/75	75	16	N	449
25	Assembly	Make-it 386 to 486	Improve	--	TI 486SXLC2 25/50	50	8	N	279
33	Chip	Rev to 486 (386SX2+)	Evergreen	288	TI 486SXLC2 20/40	33	8	N	229
33	Assembly	Rev to 486 (386SX3+)	Evergreen	300	IBM Blue Lightning 33/66	66	16	N	449
386DX Upgrade Options									
16	Chip	DRx2	Cyrix	15061-02	Cyrix Cx486DRx5-25/50	32	1	N	249
16	Chip	Rev to 486 (386DX2+)	Evergreen	259	TI 486SXL2 20/40	32	8	N	229
16	Assembly	Rev to 486 (386DX3+)	Evergreen	261	IBM Blue Lightning 20/60	48	16	N	349
16	Assembly	Lightning 486	Kingston	486/CL66	IBM Blue Lightning 33/66	32	16	N	255
20	Chip	DRx2	Cyrix	15061-20	Cyrix Cx486DRx2-25/50	40	1	N	249
20	Chip	Rev to 486 (386DX2+)	Evergreen	259	TI 486SXL2 20/40	40	8	N	229
20	Assembly	Rev to 486 (386 DX3+)	Evergreen	261	IBM Blue Lightning 20/60	60	16	N	349
20	Assembly	Lightning 486	Kingston	486/CL66	IBM Blue Lightning 33/66	40	16	N	255
25	Chip	DRx2	Cyrix	15061-02	Cyrix Cx486DRx2-25/50	50	1	N	249
25	Chip	Rev to 486 (386DX2+)	Evergreen	259	TI 485SXL2 20/40	25	8	N	229
25	Chip	Rev to 486 (386DX2+)	Evergreen	271	TI 486SXL2 25/50	50	8	N	279
25	Assembly	Rev to 486 (386DX3+)	Evergreen	263	IBM Blue Lightning 25/75	75	16	N	449
25	Assembly	Make-it 386 to 486	Improve	--	TI 486 SXLC2 25/50	50	8	N	279
25	Assembly	Lightning 486	Kingston	486/CL66	IBM Blue Lightning 33/66	50	16	N	255
33	Chip	DRx2	Cyrix	15071-02	Cyrix Cx486DRx2-33/66	66	1	N	299
33	Chip	Rev to 486 (386DX2+)	Evergreen	259	TI 486SXLC2 25/50	33	8	N	229
33	Chip	Rev to 486 (386DX2+)	Evergreen	263	IBM Blue Lightning 33/66	66	16	N	449
33	Assembly	Rev to 486 (386DX3+)	Evergreen	265	IBM Blue Lightning 33/100	100	16	N	749
33	Assembly	Lightning 486	Kingston	486/CL66	IBM Blue Lightning 33/66	66	16	N	255

486SX Upgrade Options

20	Chip	Rev to DX4 (75 MHz)	Evergreen	547*	Intel DX4/75	60	16	Y	599
20	Chip	IltelSX2 (50 MHz)	Intel	SX2ODP50	Intel SX5/50	40	8	N	149
20	Chip	IntelDX2 (50 MHz)	Intel	DX2ODP50	Intel DX2/50	40	8	Y	199
20	Chip	IntelDX4 (75 MHz)	Intel	DX4ODP75	Intel DX4/75	60	16	Y	549
25	Chip	Rev to DX4 (75 MHz)	Evergreen	547*	Intel DX4/75	75	16	Y	599
25	Chip	IntelSX2 (50 MHz)	Intel	SX2ODP50	Intel SX2/50	50	8	N	149
25	Chip	IntelDX2 (50 MHz)	Intel	DX2ODP50	Intel DX2/50	50	8	Y	199
25	Chip	IntelDX4 (75 MHz)	Intel	DX4ODP75	Intel DX4/75	75	16	Y	549
33	Chip	Rev to DX4 (100 MHz)	Evergreen	548*	Intel DX4/100	100	16	Y	669
33	Chip	Make-it 486 to 486DX4	Improve	–	Intel DX4/100	100	16	Y	499
33	Chip	IntelDX2 (66 MHz)	Intel	DX2ODP66	Intel DX2/66	66	8	Y	299
33	Chip	IntelDX4 (100 MHz)	Intel	DX4ODP100	Intel DX4/100	100	16		649
50	Chip	Rev to DX4 (100 MHz)	Evergreen	548*	Intrl DX4/100	100	16	Y	669

486DX Upgrade Options

25	Chip	Rev to DX4 (74 MHz)	Evergreen	547*	Intel DX4/75	75	16	Y	599
25	Chip	IntelDX2 (50 MHz)	Intel	DX2ODP50	Intel DX2/50	50	8	Y	199
25	Chip	IntelDX4 (75 MHz)	Intel	DX4ODP75	Intel DX4/75	75	16		549
33	Chip	Rev to DX4 (100 MHz)	Evergreen	548*	Intel DX4/100	100	16	Y	669
33	Chip	IntelDX2 (66 MHz)	Improve	DX2ODP66	Intel DX4/100	100	16	Y	499
33	Chip	Make-it 486 to 486DX4	Intel	DX4ODP100	Intel DX2/66	66	8	Y	299
33	Chip	IntelDX4 (100 MHz)	Intel	DX4ODP 100	Intel DX4/100	100	16	Y	649
50	Chip	Rev to DX4 (100 MHz)	Evergreen	548*	Intel DX4/100	100	16	Y	669

*$59 without DX4 processor

Both Cyrix and Intel are silicon foundries that offer single-chip upgrade solutions. Cyrix focuses on the 386SX and 386DX markets, while Intel addresses the 486SX and 486DX sectors. Kingston provides custom upgrades mainly for IBM PS/2 and Compaq systems, but it's starting to branch out with its new Lightning 486 upgrade for 386DX clones.

A newcomer here is Improve Technologies, whose line has been expanded from 286-only to the entire range of 286 to 486DX4 coverage. Unfortunately, a promising upgrade vendor, H. Co. Computer Products (Tel: 714-833-3222), an OEM supplier of upgrade products, couldn't decide in time if it wanted to be included in this roundup.

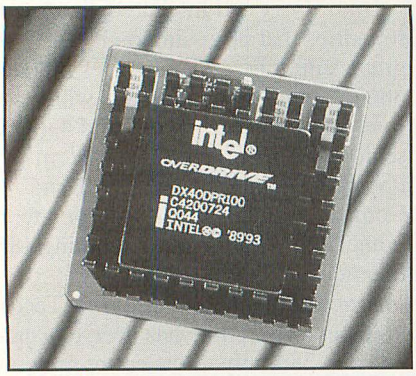
To make the selection process as painless as possible, the upgrade world divides itself into 80286, 80386SX, 80386DX, 80486SX and 80486DX upgrade camps. This processor-type grouping gives you an easy and accurate way to quickly determine the correct upgrade for your system.

The graphs in this article detail the relative performance of the upgrade products and provide a price-to-performance ratio to help you make the important upgrade decision. Sometimes, an upgrade processor can be used with more than one class of system. For example, Evergreen's Rev To DX4 is compatible with 486SX, 486SX2, 486DX and 486DX2 PCs.

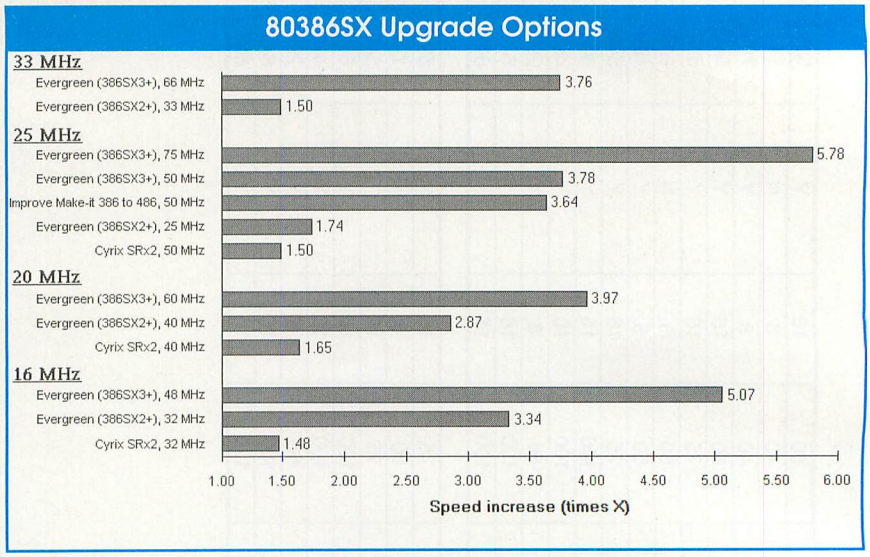
• **286 Upgrades.** Evergreen is the major provider of 286 upgrades. Its Rev To 486 (286) daughterboard module converts more than 200 different models of 286-based computers, ranging in speed from 6 to 16 MHz, into a 486SLC system. It features an IBM 486SLC2 processor with 16K of internal cache RAM and comes in four models to accommodate different 286 form factors and math-coprocessor options. Prices range from $249 to $299.

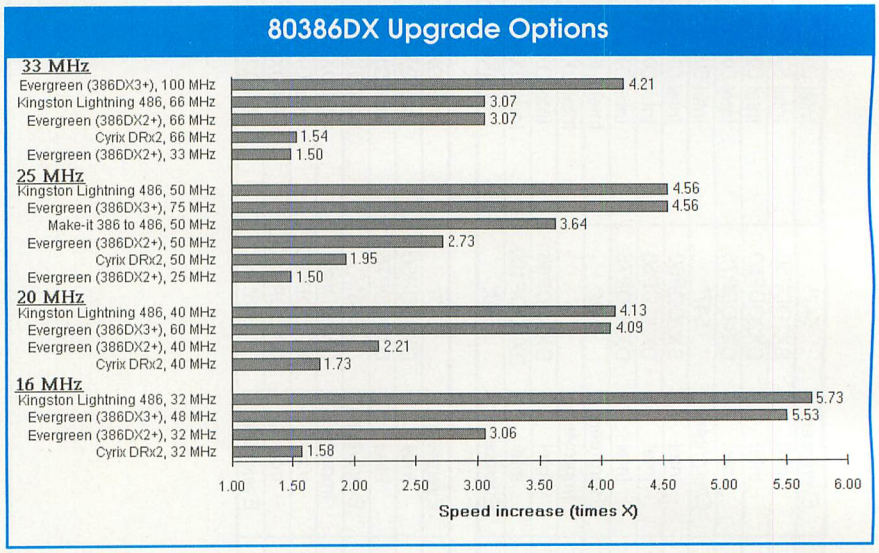
Rev To 486 (286) is built on a 1.6" X 2.4" circuit board that includes a socket for an optional 80387SX math coprocessor and clock circuit. The onboard clock drives the 486SLC2 at speeds of 50 MHz for 6- to 10-MHz systems and 66 MHz for 12- and 16-MHz systems. A phase-locked loop (PLL) keeps the asynchronous clock in step with the motherboard's clock.

Improve Technologies' Make-it



Intel's OverDrive processors are the most famous and popular upgrade CPUs. The OverDrive's clock-doubling architecture is designed to upgrade 486SX and 486DX systems. These chips come in two pinout configurations, the DX2ODPxx and DX2ODPRxx. The one you choose depends on whether the OverDrive goes into an upgrade socket or replaces the existing CPU.





486 (286) is similar to Evergreen's Rev To 486 (286), except that it features a Cyrix 486SLC, rather than its TI equivalent. Like all Cyrix products, the internal cache is a small 1K, which is reflected in its poorer performance. With a 387SX math coprocessor, the 1.5" X 2" module sells for $299. Without a math coprocessor, list price is $249.

• **386SX Upgrades.** Owners of 386SX computers have their choice of five upgrade products: one from Cyrix, three from Evergreen and one from Improve.

Cyrix's Cx486SRx² Upgrade Microprocessor is a single-chip upgrade that's packaged in a skirted module that has a plastic shroud. It uses a modified Cyrix Cx486SLC processor with 1K of internal cache RAM and is compatible with most 16-, 20-, and 25-MHz 386SX systems. It provides 486SLC performance at speeds of 32, 40 and 50 MHz, respectively. Price is $249.

Evergreen's Rev To 486 (386-SX2+) is also a snap-on skirted module that's built around a single chip. Powered by a TI 486SLC2 processor with 8K of internal cache, this upgrade works with most 386SX-based systems that run at up to 33 MHz and can provide 486SLC performance up to 40 MHz. It's priced at $229.

Evergreen's Rev To 486 (386-SX3+) 386SX upgrade offering is based on IBM's legendary Blue Lightning processor. The processor is mounted on a comparatively-large 2" X 2.5" daughterboard, along with two ASICs (application-specific integrated circuit) and four "glue" chips. Unlike the Rev To 486 (386SX2+), which has a top speed of 40 MHz, Rev To 486 (386SX3+) uses a clock-tripler that can boost a 16-MHz 386SX system to 48 MHz or a 25-MHz 386SX system to 75 MHz (33-MHz 386SX systems run at 66 MHz). Prices are $349 and $449, respectively.

• **386DX Upgrades.** With 19 upgrade options from which to choose, the 386DX is the most upgrade-able CPU at the moment. Upgrades are equally divided between single-chip and board-assembly products.

The single-chip Cx486DRx² Upgrade Microprocessor is based on the Cyrix 486DLC processor. Unlike single-chip designs from Evergreen, where the "chip" is made up of composite layers, the Cx486DRx² upgrade is a monolithic ceramic block that has the same dimensions as the original 386DX2 chip. It's essentially a clock-doubler CPU with 1K of internal cache that accelerates the host system up to 66 MHz when installed in a 33-MHz 386DX PC. This chip comes in $249 50-MHz and $299 66-MHz versions.

Again, Evergreen serves up two versions of the 386DX upgrade based on 486SXL processors from TI and IBM. Its Rev To 486 (386DX2+) single-chip upgrade is powered by a TI 486SXL2 processor. Although it has the same footprint of the original 386-

DX, it's not a monolithic device. Rather, it's made up of a plastic chip carrier that plugs into a converter socket, which plugs into a bottom connector plate. Height of the layered structure, which is about the same as a 386DX with a heat sink, is 3/4".

This upgrade supports virtually all 386DX desktop PCs in the 16- to 33-MHz range, and it runs internally at speeds up to 50 MHz. A 40-MHz 386DX version is in the works. The Rev To 486 (386DX2+) has an 8K internal cache and sells for a low $229.

Like its Rev To 486 (386SX3+) counterpart, the Rev To 486 (386-DX3+) upgrade cranks a system up to clock-tripling Blue Lightning 486 performance. Armed with 16K of internal cache, it's the fastest 386DX upgrade you can buy. It can even push a 33-MHz 386DX to 100 MHz. But the price of power isn't cheap. At 1.6" X 2.4", it takes up a fairly sizable chunk of real estate and, as a consequence, may not fit in all systems, despite Evergreen's unique rotation sockets. And 100-MHz performance is going to set you back a cool $749—about half the cost of a Pentium clone without video monitor. The 66-MHz version sells for $449, and the 50-MHz module is priced at $349.

Improve's Make-it 386 to 486 386DX upgrade is powered by a TI 486SXLC2 with 8K of internal cache. While its speed improvement is on a par with other 386DX upgrades and its price is a relatively low $279, it can't run any faster than 40 MHz.

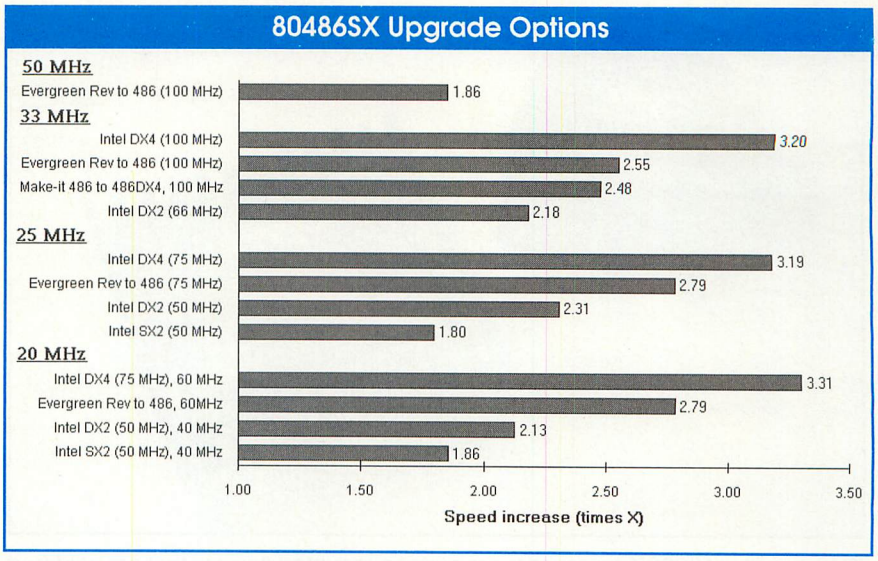
Kingston's Lightning 486 Model 486/CL66 is a generic version of its popular Lightning 486 module that was designed and manufactured by IBM to upgrade 386DX-based PS/2 Models 70 and 80 to clock-doubled performance using IBM's Blue Lightning processor. Kingston describes the upgrade's pc board as being "one-half the size of a playing card," or about 2.1" X 2.5". At press time, the upgrade module was slated to sell for $255 in all versions up to 66 MHz (33-MHz 386DX, doubled). A $345 clock-tripled 100-MHz version is scheduled for release early this year. If it comes to pass, this will make the Lightning 486 the best bang for your 386DX upgrade buck.

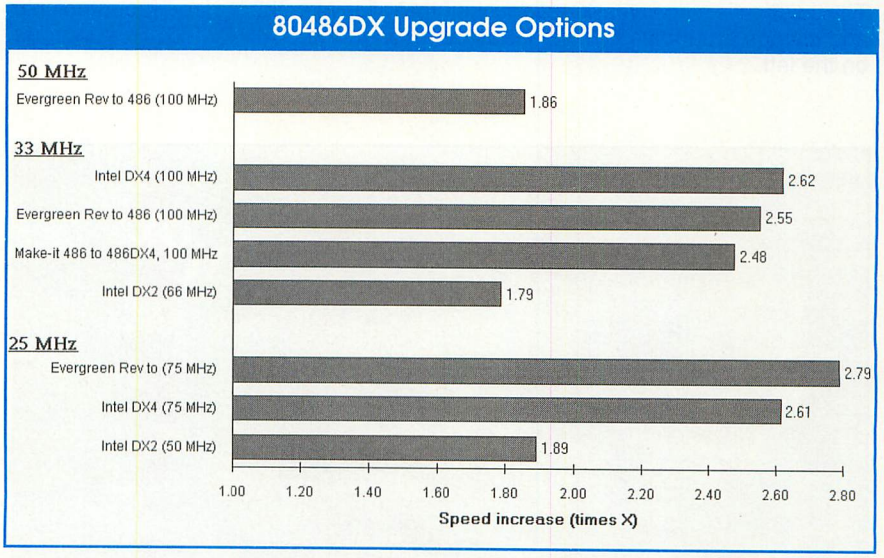
• **486 Upgrades.** If you're not intimidated and wish to enter the fray, the 486-upgrade plunge will certainly open your eyes, imagination and pocketbook—albeit not necessarily in this order. With this being a fast-moving market, hardware options and prices change rapidly.

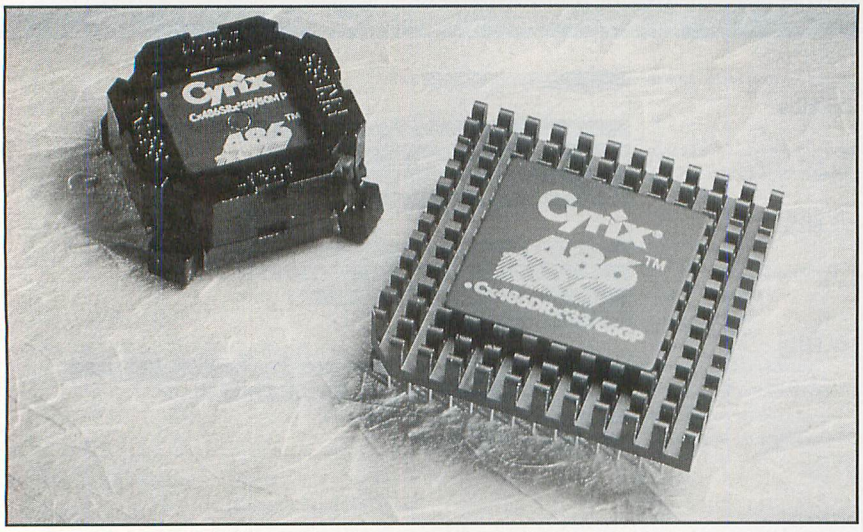
Intel OverDrive processors are the mainstay of 486 CPU upgrades. Whether you wish to add floating-point math capability to your 486SX or triple the speed of your 486DX, Intel has the vehicles to deliver the goods.

If all you want to do is double the speed of your 20/25-MHz 486SX or 486DX system—and do it as inexpensively as possible—you may want to cast an eye toward the IntelSX2 OverDrive chip. The IntelSX2 features clock-doubling circuitry and an 8K internal cache. Since it doesn't have an on-chip FPU (floating-point unit), it can't give the additional boost that an Intel486DX2 can provide. In fact, if you decide to go from a 486DX to an IntelSX2, you'll gain speed for database and text applications, but you'll just break even on spreadsheet and CAD applications. Nonetheless, $149 for a clock doubler isn't a bad way to perk up a poky 20- or 25-MHz 486 system, especially if you can live without a math coprocessor.

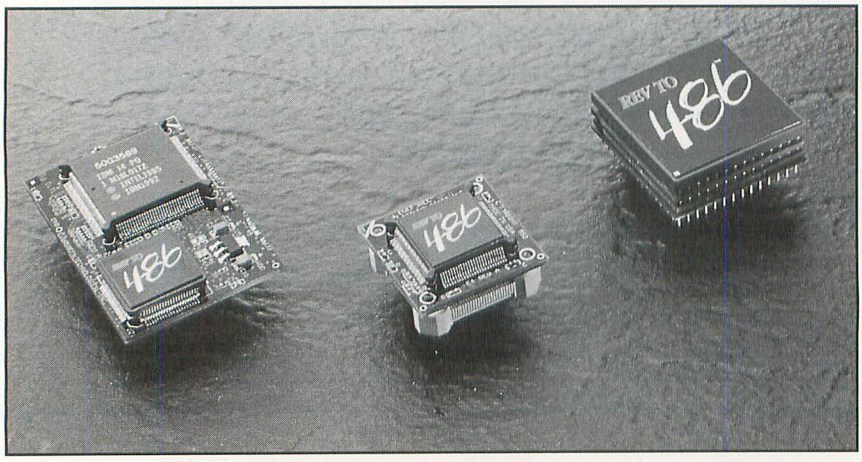
For a mere $50 more ($199), you can have a math coprocessor, clock doubling and 8K of internal cache by upgrading to an IntelDX2. Unlike the Intel486SX2, which tops out at 50 MHz, the Intel486DX2 keeps on going and going, all the way to 66 MHz to deliver the same performance as an "Intel inside" DX2 system. However, the drum-pounding is going to cost you $299.







The majority of 386SX processors are surface-mounted devices that are soldered directly to the motherboard. In the beginning, this posed an upgrade challenge. The solution is a special, skirted "socket" that slips over the surface-mounted chip and clamps around its gull-like leads, as seen in the Cyrix Cx486SRx^2 upgrade on the left.



Evergreen carries a complete line of upgrade processors for Intel-compatible computers, including all models from 286 to 486, with promise of Pentium upgrades in the near future. Pictured here are two 386SX upgrades (left and center) and a 386DX upgrade (right).

The IntelDX4 OverDrive is the fastest member of the Intel OverDrive processor family. It can upgrade all versions of 486SX, 486SX2, 486DX and 486DX2 processors. In fact, it leaves no 486 stone unturned. This high-end CPU upgrade incorporates speed-tripling technology with an FPU and 16K of internal cache. Installed in a 33-MHz 486DX system, it delivers 32-bit 100-MHz performance that closely matches that of a 60-MHz Pentium system. But at $669, it's not one of your bargain-basement upgrades.

Intel doesn't have a corner on the 486 upgrade market. AMD and Evergreen both have a decent line of 486 upgrade products, with Improve Technologies making a dent, too. At the lowest level are 486-to-DX2 and 486-to-DX4 upgrades.

While AMD doesn't offer an OverDrive chip as such, all of its 486 processors are on a par with Intel's and can be substituted for an OverDrive chip in many situations, at a 10% cost saving.

Evergreen and Improve, on the other hand, take the technology a step further via an upgrade called the Rev To DX4 and Make-it 486 to 486DX4, respectively. Built around Intel's clock-tripling IntelDX4, these upgrades are essentially plug adapters that convert the DX4's pinout to that of the host processor. The secret is a voltage regulator that converts an older PC's 5-volt power line to the 3.3 volts needed by the 486DX4. Since introduction of these 486-to-DX4 converters, Intel has also cleaned up its act and made the 486DX4 5-volt tolerant, which means it can plug into any 486 socket, regardless of power-supply voltage.

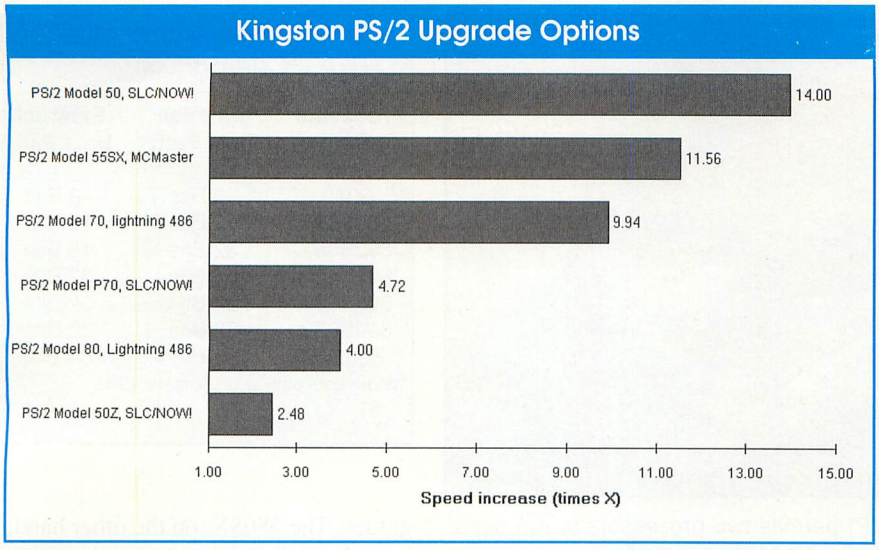
Evergreen and Improve's upgrades still remain viable options because they also work with AMD's 100-MHz DX4 processor that, at present, isn't 5-volt tolerant. Pricing on these devices is all over the place while the market shakes out. So if you're looking for this upgrade, the best advice is to call around for the best price.

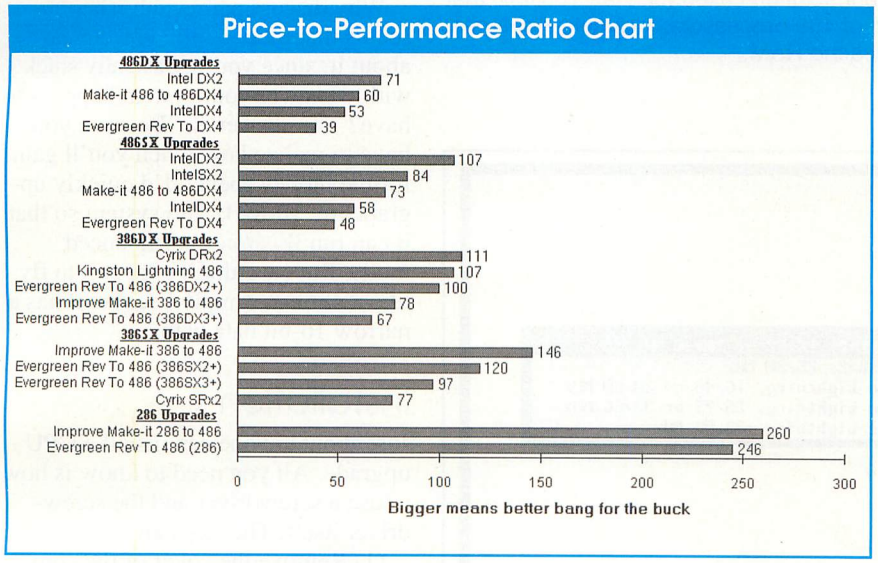
New to the market and contemporary desktop thinking is SMP, or Symmetric Microprocessors. Now available on select motherboards, this technology permits two processors to run separate codes at the same time in parallel to deliver a solution in less than half the time it would take for a single processor to do the same job.

Parallel processing was originally devised as a way to make mainframe computers more efficient, and it appears to be the way desktop PCs will go in the future, given time. The drawback is that it requires special programming so that the processors don't duplicate their efforts. In any event, if you're interested in parallel processing, Evergreen offers an eloquent solution with the not-so-eloquent name of Rev To SMP, a barebones daughtercard that you wed to a 486SX, 486DX, 486SX2, 486DX2, DX4 or OverDrive processor in any combination to increase performance. Evergreen has even made room for up to 256K of external cache RAM on this extremely large daughtercard.

Evergreen plans its 486 to SMP to be compatible with CPUs from AMD, Cyrix, IBM, TI and SGS Thompson in the near future. Current cost of the 486 to SMP is $499, processors not included.

• **IBM PS/2 & Compaq Deskpro Upgrades.** IBM PS/2 and Compaq Deskpro computers pose an upgrade challenge because of their unique archi-





tecture. Filling this niche market are daughterboard upgrades from Kingston Technology. The company's vanguard product is the 486/NOW! upgrade adapter that's designed to move the PS/2 Model P70 and Compaq Deskpro 386 up to 33-MHz 486-SX or 486DX performance. This module is powered by an AMD processor that's supported by an 8K internal cache. DX versions include a math coprocessor. Prices range from $295 to $425, depending on speed and math-coprocessor options.

If you have a PS/2 Model 25/286, 30/286, 50, 50Z, or 60 you'll find the SLC/NOW! the perfect upgrade route for it. Based on an IBM 486SLC or 486SLC2 processor, depending on speed, this upgrade is designed and manufactured by IBM for utmost reliability and comes with a lifetime warranty. Prices range from $129 to $295.

If you own a MicroChannel-based PS/2, Kingston addresses your plight with the MCMaster—an MCI plug-in adapter board. MCMaster is specifically designed for IBM PS/2 MicroChannel Models 55, 56, 57 and 65. It has 8K of internal and 128K of external cache RAM. The upgrade board also sports two SIMM sockets that can add 64M of RAM to a system. But take a deep breath, because it's going to cost you a cool $695 to take the plunge.

The latest and greatest upgrade from Kingston is the Lightning 486, which is specifically designed for PS/2 Models 70 and 80. Based on IBM's Blue Lightning processor, this upgrade module has 16K of internal cache with write-back for faster throughput when operating in clock-doubling mode. An on-board, asynchronous clock drives the processor at 66 MHz, regardless of native bus speed. It's priced at $395.

Nuts and Bolts

What makes one CPU upgrade faster than another? The answer is: lots of things—like clock speed, cache size and bus width. Here are the factors involved and their impact on performance.

• **Clock Speed.** It has been a long time since the CPU ran at the same speed as the motherboard—even for 486 machines. Most CPUs today run two or three times faster than the motherboard. All the upgrades discussed in this article certainly do. Here's how it works.

Inside the CPU is a special circuit that's triggered by the motherboard's clock to double or triple its frequency. This is usually done by using both the rising and falling edges of the clock signal to trigger internal logic that converts these events into square waves. In the case of a speed-doubler, the leading edge of the master clock drives high the CPU's clock line, and the falling edge forces it low.

Since there are two rising and falling edges in a single clock cycle, the end result is a clock that's double the speed of the original clock. Speed-tripling is done by again using the rising and falling edges and processing them through exclusive-OR logic.

Doubling CPU speed doesn't always double the rate at which a PC does its work. Speed increase depends upon the application. Overall, you can expect a 50% increase in performance when using a clock-doubled processor. Processor-intensive applications like *Excel* gain the most, with an average speed boost of 250%. Database applications like *Paradox* fare less-well because they make heavy use of the hard disk, the speed of which doesn't improve via a CPU upgrade. Clock-triplers generally increase overall performance by 100%, with the same hard-disk restrictions.

• **On-board Cache.** Caching can significantly boost the performance of a system. However, it wasn't until development of the 486 processor that caching became an integral part of the

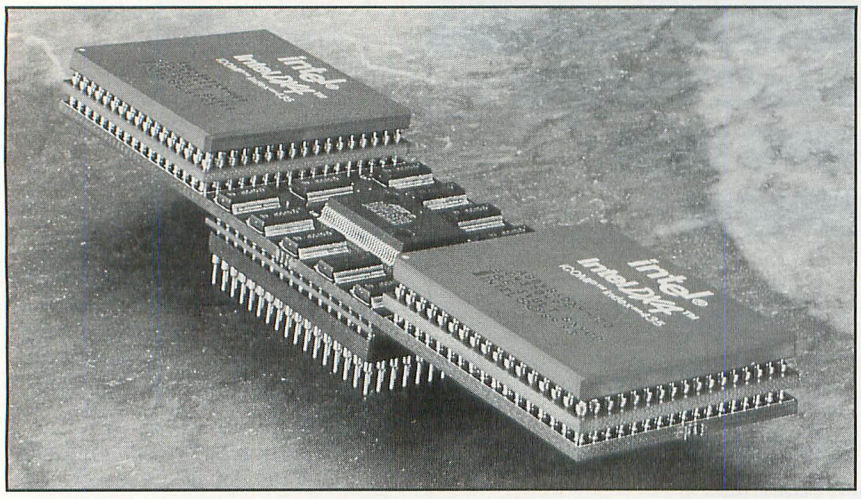


Fig. 4. Symmetric Microprocessors (SMP) permits two processors to run separate code at the same time, in parallel. Parallel processing is available as an option on select 486 and Pentium systems. If you wish to upgrade your present 486 system to SMP, Evergreen offers an eloquent solution called the Rev To SMP that lets you mix and match any combination of 486 processors, including Pentiums, and has provisions for 256K of external cache RAM.

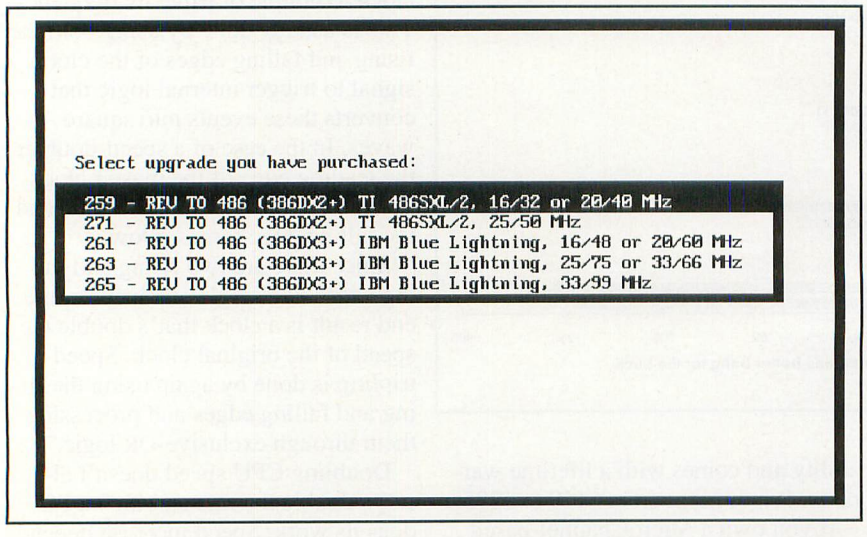


Fig. 5. If you don't know what type of processor is under the hood of your machine, simply run DOS's MSD program. Choosing the Computer option shows you additional details about your CPU, BIOS and math coprocessor.

CPU. Neither the 286 nor the 386 processors have provisions for an internal or external cache. Fortunately, all the upgrade CPUs discussed here have a built-in internal cache. Cache size is particularly important to performance. Generally, the larger the cache, the faster the processor.

With just 1K, Cyrix processors have the least amount of internal cache, and it shows in their performance ratings. TI chips do better with 8K of internal cache, and IBM's Blue Lightning comes equipped with a whopping 16K of cache RAM. All these processors also support an external (secondary) cache, but only Evergreen's Rev To SMP module has provisions for it.

• **Bus Width.** The amount of performance you obtain from a 386-to-486 upgrade depends heavily on both the internal and external data paths. 386DX and 486 processors support 32-bit external and internal data paths, which makes them the best-performing upgrades. The 386SX, on the other hand, has a limited 16-bit external data interface, which hinders performance.

Why discuss path width when it seems that there's little you can do about it, since you're basically stuck with whatever your system happens to have? The answer is, "Because you have to realize how much you'll gain for the money spent." I'd quickly upgrade my 10-MHz 286 system so that it can run *Windows* in Enhanced mode. But I wouldn't expect it to fly like a 486DX, simply because it has a narrow 16-bit data path.

Processor Data Path Comparison*

Processor Type	Internal Data Path	External Data Path
8088	8 Bits	8 Bits
80286	16 Bits	16 Bits
80386SX	32 Bits	16 Bits
80386DX	32 Bits	32 Bits
80486SX	32 Bits	32 Bits
80486DX	32 Bits	32 Bits
Pentium	64 Bits	64 Bits

*Wider data path signifies faster CPU.

Installation

Just about anyone can install a CPU upgrade. All you need to know is how to use a screwdriver and the screwdriver itself. The steps are:

(1) Remove the cover of the computer's system unit.

(2) Locate the CPU.

(3) Remove the CPU and replace it with the upgrade

(4) Replace the cover on the system unit.

You can complete the entire process in as little as 15 minutes. However, there are some things you should know before going under the hood.

• **286 Systems.** The 286 processor comes in PGA, PLCC and LCC[2] form factors. PGA (pin gate array) packages look like a bed of nails that plug into an open-frame socket and are commonly used with systems that run at speeds of 6, 8 and 10 MHz.

PLCC (plastic leaded chip carrier) packages are 1" plastic squares that have their contacts molded into the bodies of the chips around their edges. They plug into a well socket

and require a special extraction tool (supplied with the upgrade chip) to remove them.

The more-popular LCC² (leadless chip carrier) has its metal contacts on the bottom of the carrier, similar to the way traces are laid down on a printed-circuit board. The chip lies on top of a spring-loaded socket that has a matching contact pattern and is held in place with a metal clip that doubles as a heat sink. LCC² -socketed systems require an additional cable or adapter.

• **386SX Systems.** Because most 386-SX processors are soldered into place, making it virtually impossible to remove them, the success of a 386SX upgrade hinges on the ability to disable the 386SX processor. Toward the latter part of 1990, Intel 386SX processors were built with a special float pin, the original purpose of which was to disable the processor for production testing.

Most 16-MHz 386SX processors manufactured prior to 1991 were designed without the float pin and aren't capable of being upgraded. So before you plunk down big bucks for a 386-SX upgrade, you're advised to see if it can be upgraded. Cyrix and Evergreen have a software program that can test for the presence or absence of the float pin and, by inference, the system's ability to be upgraded. You can obtain the program free by calling technical support or downloading it from either company's BBS. All 20- and 25-MHz 386SX processors have the float pin and can be upgraded.

Installing a 386SX upgrade is a snap, literally. All you need do is place the upgrade over the 386SX processor and snap it into place. However, if your 386SX system has a socketed CPU, you need an adapter socket that converts the PGA form factor to surface-mount. So check before you order.

• **386DX Systems.** A few 386DX computers, specifically some Memorex and Packard Bell PCs, won't work with generic upgrades like the Cyrix Cx486DRx². The problem is in the BIOS. Most BIOS problems can be cured by upgrading the BIOS chip at the same time you upgrade your CPU. Check with your upgrade retailer or the vendor's technical support for details.

Some early 386DX systems were designed with an 80287 math coprocessor instead of an 80387DX. In most cases, the math coprocessor must be removed before the upgrade will work, which could leave you without a math coprocessor should your upgrade not provide one.

More often than not, a daughterboard upgrade won't fit into a system because other components or wires are obstructing the way. Quite often, though, all it takes is a twist of the module to the left or right to clear the obstruction. Evergreen handily solves this problem with rotation sockets that cost $49 each and come in 90°, 180° and 270° rotations so that you can twist and turn the upgrade as needed.

• **486SX Systems.** While nearly all 486 processors are packaged in a 168-pin ceramic PGA carrier, the 20- and 25-MHz 486SX can be found as a surface-mounted device. Currently, there are no upgrades that support these processors, unless the motherboard or processor board contains an empty upgrade socket.

When upgrading a 486SX system to Intel OverDrive, you often have to set jumpers on the motherboard. The reason is that the pinouts differ just slightly, and you need to enable another V_{cc} line for the new chip that's disabled when the SX processor occupies the socket. Even if you don't have to remove the original CPU, many 486SX systems have a separate upgrade socket for the OverDrive chip, and jumper setting may be required for the sake of the BIOS.

About Upgrade Processors

While CPU upgrades number in the dozens, there are only a handful of processors that power these upgrade products. They come from just four vendors—Cyrix, IBM, Intel and Texas Instruments—and are either modifications of an OEM processor or, in the case of the IBM Blue Lightning processor, a device you're likely to see in PC clones. Here's a look at what's inside these powerhouses and what makes them tick.

Cyrix's Cx486SRx² and Cx486DRx² processors are based on the company's Cx486SLC and Cx486DLC processors and are specifically targeted at the upgrade market. They're single-cycle 486 instruction-set-compatible processors that have 1K of internal cache. Both are clock-doubled, which lets them operate at twice the speed of the original microprocessor. However, they tend to run very hot, and Cyrix recommends a heat sink when used in systems that run faster than 20 MHz. The Cx486SRx² is a surface-mounted device that tops out at 50 MHz, whereas the Cx486DRx² is a 132-pin PGA device that can accelerate to 66 MHz.

IBM serves two upgrade markets with its processor chips. One is the 286 upgrade community, which depends heavily on the IBM 486LC2, an OEM product that's often found in notebook and low-end desktop computers. The chip comes in a miniature surface-mounted package, sports a hefty 16K cache and runs at a software-select-able speed of 50 or 66 MHz.

IBM's Blue Lightning processor is found in many desktop computers. It's legendary because of its extraordinary speed, which is sparked by a huge 16K cache and clock-tripler circuitry. Actually, the CPU can run in either clock-doubled or clock-tripled mode. Mode selection is software-select-able. The Blue Lightning is a surface-mounted device that has a top speed of 100 MHz.

Intel's OverDrive processors are essentially 486DX2 CPUs that are sold as upgrade products, rather than OEM devices. They contain clock-doubler circuitry and the standard 8K of internal cache found in all 486 products. The 486DX4 is a triple-clocked version of the 486DX2 and is sold both as OEM and upgrade devices. The OverDrive's claim to fame is extremely easy installation and perfect compatibility with "Intel inside" systems.

TI's 486SXLC2 and 486SXL2 upgrade processors are based on the original 486SLC processor that were developed by Intel. These chips contain 8K of internal cache and are used for upgrades in both 386SX and 386DX computers. The 486SXLC2 is a surface-mount device, and the 486SXL2 is a 132-pin PGA package. Both chips contain a clock-doubler circuit, but they can also run at the same frequency as the motherboard. You might well ask, "Why would you want to do that?" The answer is, "Simply because the 486SXLC2 tops out at 40 MHz and the 486SXL2 runs out of steam at 50 MHz." So by running in the 1X mode, you can add 486 performance to a 33-MHz system without burning up the upgrade processor.

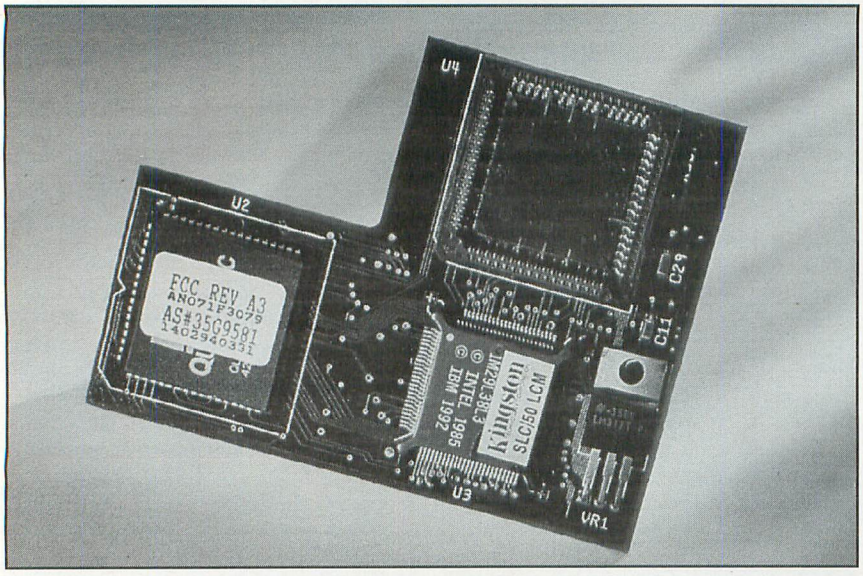


Fig. 6. PS/2 owners can upgrade their systems with daughterboards from Kingston that, like the SLC/NOW! shown above, are specifically designed to work with the PS/2's BIOS and don't need a software utility to enable the cache.

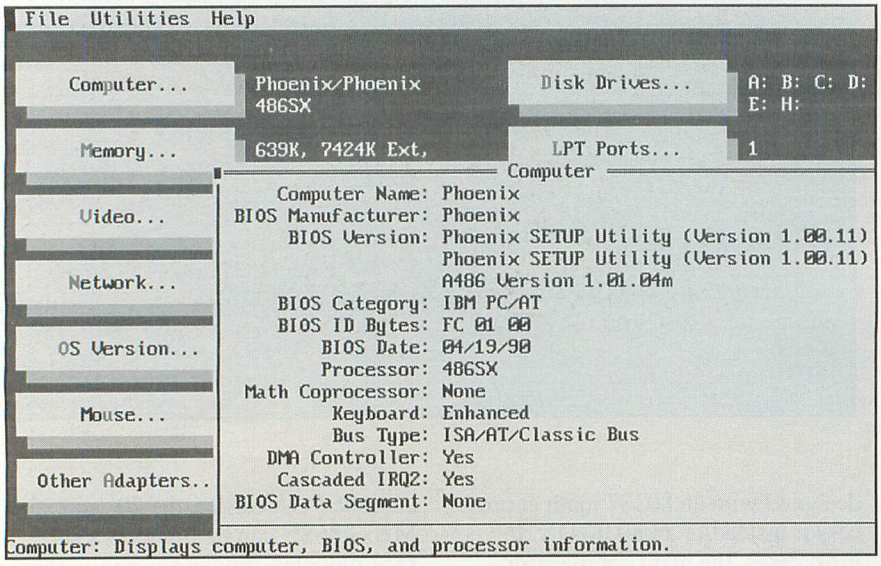
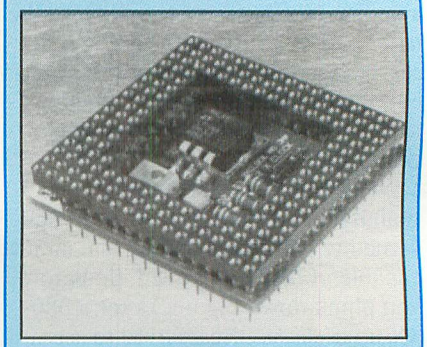


Fig. 7. Since 286 and 386 processors don't support an on-chip caching, you have to run a utility program to enable the internal cache, like this one from Evergreen.

Using 3.3-Volt CPUs on Existing 5-Volt-Only Motherboards

Users of 486 PCs that utilize the 5-volt i486DX/DX2 CPU can upgrade to increased performance of Intel's high-speed 3.3-volt DX4 chip (and 3.3-volt CPUs from other manufacturers that aren't 5-volt-tolerant) without having to change their motherboards by using upgrade modules from Aries Electronics, Inc. The Aries No. 57-486DX2U Upgrade Socket for the DX4 chip in the 169-pin PGA package or 57-486DX3U Upgrade Adapter for the DX4 in the 208-pin SQFP package makes it possible to use these CPUs on a 5-volt-only motherboard.



Both devices have built into them the circuitry required to regulate the voltage so that the 3.3-volt CPU can be used with an existing 5-volt supply. The 57-486DX2U Upgrade Socket permits placement of the DX4 chip in the socket provided as part of the Upgrade Module package and doesn't require soldering. The 57-486DX3U Upgrade Adapter provides the means for converting the SQFP package to a leaded PGA package by soldering the Intel package to the Aries adapter. Pricing for the Aries Adapter and Socket is $24.50 each in 100-piece quantities.

• **Cache Enable.** Since 286 and 386 processors don't support on-chip caches, you have to run a utility program to enable the internal cache. Generally, you load the utility onto your hard disk and add its command line to your CONFIG.SYS or AUTOEXEC.BAT file so that the software will enable the on-chip cache each time you turn on or warm-boot your computer. The utility needs to run only once per boot, which means it doesn't take up memory space, as do TSR programs.

• **Cooling.** Just like you, the faster a CPU runs, the hotter it gets. And like yourself, if the heat builds up to critical level, the CPU has a life-threatening heat stroke and either quits working or dies altogether. There are two ways to prevent this from occurring.

The most common and economical way to dissipate heat is via a metal heat sink. Like a radiator, the heat sink has fins that radiate heat into the surrounding air via convection.

Simple convection cooling isn't always enough. Sometimes, you need to force the issue by moving hot air away from the CPU, using a fan. In fact, almost every desktop computer already has a cooling fan built into its power supply to exchange the hot air inside the computer for cooler outside air. For severe heat problems, a fan is placed on top of the CPU chip itself.

Products Mentioned

Aries Electronics, Inc.
PO Box 130
Frenchtown, NJ 08825
Tel: 908-996-6841; fax: 908-996-3891;

CIRCLE NO. 148 ON FREE INFORMATION CARD

Cyrix Corp.
PO Box 853017
Richardson, TX 75085-3917
Tel: 214-994-8388; fax: 214-699-9857;
BBS: 214-994-8610

CIRCLE NO. 149 ON FREE INFORMATION CARD

Evergreen Technologies
915 NW 8 St.
Corvallis, OR 97330-6211
Tel: 503-757-0934; fax: 503-757-7350;
BBS: 503-752-9851

CIRCLE NO. 150 ON FREE INFORMATION CARD

Improve Technologies
345 E. 800 S.
Orem, UT 84058
Tel: 801-224-0088; fax: 415-286-3999

CIRCLE NO. 151 ON FREE INFORMATION CARD

Intel Corp.
Tel: 800-628-8686

CIRCLE NO. 152 ON FREE INFORMATION CARD

Kingston Technology Corp.
17600 Newhope St.
Fountain Valley, CA 92708
Tel: 714-435-2600; fax: 714-435-2699

CIRCLE NO. 153 ON FREE INFORMATION CARD

placed on top of the CPU chip itself.

At what point you need to take extraordinary cooling methods depends on the chip you're using and its operating speed. Generally, you don't have to worry about it with systems that run at 20 MHz and slower. But at 25 MHz, some CPUs, notably those from Cyrix, become overheated and need extra cooling. TI and Blue Lightning CPUs can usually make it to 50 MHz before they need help keeping their cool. At 66 MHz, every CPU needs some kind of air conditioning, and there's no question about it at 100 MHz.

Most upgrade kits come with a heat sink or cooling fan, whether you need it or not, with instructions on how to install it. Just remember that if you install a fan, it must be connected to a disk-drive power line, which means you may have to add a Y connector (supplied in the kit) if you don't have a free power cable.

Making It Work

For as little as $250 you can turn your 386 system into a 486 PC. Of course, you can't make a 386SX run as fast as a 486 PC, any more than you can make a purse out of a sow's ear. These are stop-gap measures that are intended to spark new life into a cob-web-collector or prolong the life of a working system until the Pentium issue is resolved or you have the bucks to take the plunge and buy a com-

Use a .BAT File to Copy Dissimilar Disks Revisited

Reader feedback on a previously published article

I'm an avid reader of *MicroComputer Journal* and look forward to each issue for the interesting and valuable information you publish. In the September/October 1994 issue, I noted the article "Use a .BAT to copy dissimilar disks" detailing how to copy varying size disks. This is undoubtedly a convenient way to go, and the author presented one interesting way to go about it. However, I've written a batch file to copy disks with a few more options given to the operator. My file is given in Listing 1. Save COLOR.BAT as a separate file to be called by the main program.—*John L. Hultgren, Shelton, CT; e-mail johnlh1021.aol.com*

Listing 1. Hultgren Disk-Copy Batch File

```
@ECHO OFF

REM THE LINE {ECHO ARROW [#;#M IS USED TO CHANGE THE SCREEN COLOR
REM TO GET THE ARROW CTRL-P THEN ESC ANSI MUST BE LOADED IN THE
REM CONFIG FILE FOR THIS TO WORK

echo [31;40m
   IF "%1"=="" GOTO MESSAGE
   IF "%2"=="" GOTO MESSAGE
   IF EXIST C:\DUPE2\*.* GOTO DISPLAY
REM ******************************************************
:TRANSFER
  CLS
   C:
   CD\
   xcopy %1: C:\DUPE2\*.*  /V /s /E
 GOTO TRANS
REM ******************************************************
:START
  CLS
   DELTREE /Y C:\DUPE2
   CD\
   @ECHO PUT NEW SOURCE DISK INTO DRIVE %1
   PAUSE
   xcopy %1: C:\DUPE2\*.* /V /s /E
 GOTO TRANS
REM ******************************************************
:TRANS
  CLS
   @ECHO PUT BLANK DISK IN DRIVE %2
   PAUSE
   %2:
   IF EXIST %2:\*.* GOTO DISPLAY2
   C:
   CD\
 GOTO TRANS2
REM ******************************************************
:TRANS2
  CLS
   C:
   CD C:\DUPE2
   xcopy  C:\DUPE2\*.* %2: /V /s /E
 GOTO AGAIN
```

```
REM ******************************************************
:AGAIN
  CLS
   @ECHO TO MAKE ANOTHER COPY ENTER {Y}YES
   @echo.
   @echo.
   @ECHO TO MAKE {O}NE COPY ENTER {O}
   @echo.
   @echo.
   @echo TO USE ANOTHER SOURCE DISK ENTER {A}
   @ECHO.
   CHOICE/c:yoax  CHOOSE AN OPTION OR X TO EXIT PROGRAM
   if errorlevel==4 goto end
   IF ERRORLEVEL==3 GOTO START
   IF ERRORLEVEL==2 GOTO CONT
   IF ERRORLEVEL==1 GOTO TRANS
REM ******************************************************
:CONT
  CLS
   @ECHO REMOVE DISK FROM DRIVE %2
   PAUSE
   @ECHO.
   @ECHO.
   @ECHO ENTER "Y" TO REMOVE TRANSFERRED DATA FROM SYSTEM
   @ECHO.
   @ECHO.
   @ECHO ENTER "N" TO LEAVE DATA IN SYSTEM
   C:
   CD\
   DELTREE  C:\DUPE2
 GOTO CHKAGAIN
REM ******************************************************
:DISPLAY
  CLS
   CD\DUPE2
   DIR /P/W
   @ECHO.
   @ECHO ENTER "Y" TO REMOVE OLD INFORMATION FROM THE SYSTEM
   @ECHO.
   @ECHO ENTER "N" TO SAVE OLD INFORMATION IN THE SYSTEM
   C:
   DELTREE  C:\DUPE2
   IF EXIST C:\DUPE2\*.* GOTO CHKAGAIN
 GOTO TRANSFER
REM ******************************************************
:display2
  CLS
   %2:
   DIR,/P/W/S
   @echo SAVE THIS INFORMATION {S}
   @ECHO.
   @ECHO DELETE THIS INFORMATION {D}
   @ECHO.
   CHOICE/C:SDX CHOOSE AN OPTION, TO EXIT PROGRAM ENTER {X}
   IF ERRORLEVEL==3 GOTO EXIT3
   IF ERRORLEVEL==2 GOTO KILL
   IF ERRORLEVEL==1 GOTO END2

REM ******************************************************
:CHKAGAIN
  CLS
   IF EXIST C:\DUPE2\*.* GOTO end
 GOTO EXIT
REM ******************************************************
:KILL
  CLS
   %2:
```

```
   deltree /y %2:
 GOTO TRANS2
REM *******************************************************
:END2
  CLS
   @ECHO WOULD YOU LIKE TO TRY ANOTHER DISK? {Y}
   @ECHO .                                    .
   @ECHO WOULD YOU LIKE TO EXIT THE PROGRAM? {X}
   @ECHO .                                    .
   CHOICE /CYX CHOOSE AN OPTION
   IF ERRORLEVEL==2 GOTO EXIT3
   IF ERRORLEVEL==1 GOTO TRANS
REM *******************************************************
:EXIT3
  CLS
   %2:
   DIR /P/W
 GOTO EXIT
REM *******************************************************
:end
  CLS
   dir c:\dupe2\*.*/p/w
 GOTO EXIT
REM *******************************************************
:MESSAGE
  CLS
   @ECHO     ============================================
   @ECHO     =  YOU MUST HAVE A SOURCE AND A DESTINATION  =
   @ECHO     =        DRIVE IN THE STATEMENT              =
   @ECHO     =                                            =
   @ECHO     =    EXAMPLE : DUPE A A                      =
   @ECHO     =              DUPE A B                      =
   @ECHO     =              DUPE B A                      =
   @ECHO     =              DUPE B B                      =
   @ECHO     =                                            =
   @ECHO     ============================================
 GOTO EXIT
REM *******************************************************
:EXIT
  CALL COLOR.BAT
  EXIT


REM COLOR.BAT (called by main program)
echo [37;40m
```

Although Emerson M. Hoyt's batch file is useful for DISKCOPYing between dissimilar floppy disks as presented, it does contain some minor errors. One such error is that when one uses the program, the way it's displayed on-screen can be confusing. Another error is that the program makes a directory called \DCPY to store the files from one disk so that they can be transferred to the other. Yet, the program doesn't delete the \DCPY directory after it's finished, which is the main point of having such a batch file in the first place. When you try to run the program again, an error message is generated because the computer tries to create a directory that already exists. I've revised and cleaned up the original program to make it run smoothly and eliminate user confusion. The revised program is given in Listing 2.—*Jason Fawcett*

Listing 2. Jason Fawcett Disk-Copy Batch File

```
CLS
@ECHO.
@ECHO.
@ECHO THIS UTILITY WILL DO AN "XCOPY /S" FROM FLOPPY DRIVE B: TOP A:.
@ECHOHARD DRIVE C:\DCPY DIRECTORY IS USED AS THE TRANSFER STORAGE MEMORY.
@ECHOBY EMERSON M.. HOYT2/4/94
@ECHO REVISED BY JASON FAWCETT 8/30/94
@ECHO OFF
```

→

```
C:
CD\
MD DCPY
@ECHO .......
@ECHO PUT SOURCE DISK IN DRIVE "B"
PAUSE
B:\
DIR
@ECHO .......
@ECHO OBSERVE SOURCE DISK DIRECTORY AND NOTE ITS CONTENTS (BYTES)
PAUSE
XCOPY /S *.* C:\DCPY
@ECHO.
@ECHO PUT TARGET DISK IN DRIVE "A"
PAUSE
C:\
CD\DCPY
XCOPY /S *.* A:\
A:
DIR
@ECHO .......
@ECHO OBSERVE TARGET DISK DIRECTORY CONTENTS AS A CHECK
PAUSE
@ECHO COPY PROCESS COMPLETE
C:
CD\
DELTREE /Y C:\DCPY
PAUSE
CLS
C:\
```

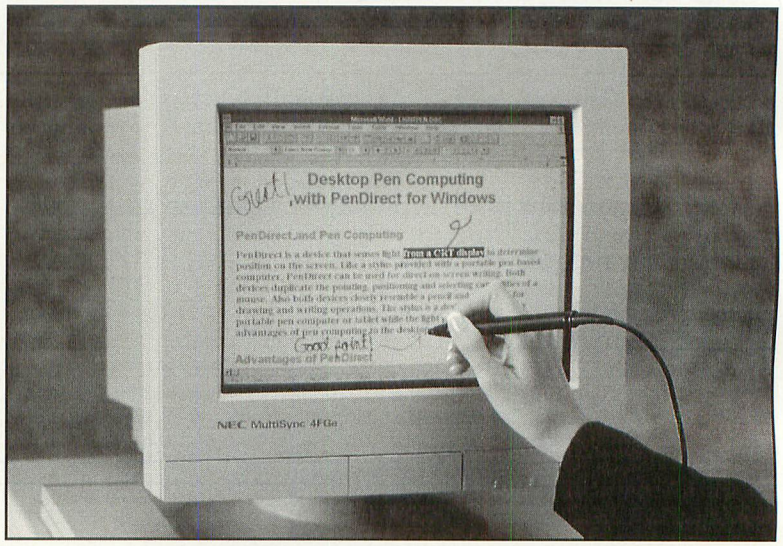
By Joe Desposito

Product Review

Pen Direct for Windows: Mightier Than the Mouse?

Using a pen with a personal digital assistant (PDA) or pen computer seems natural, especially since these devices often lack a keyboard and pointing device. Using a pen with a desktop computer, however, is a different story. With a desktop, you have a full-size keyboard and, if you're using Microsoft *Windows*, a mouse. In this case, a pen has lots of competition. The product reviewed here, FTG Systems' Pen Direct for Windows, faces this competition head on, seeking to replace the mouse and provide stiff competition for the keyboards of desktop computers.

Pen Direct for Windows has a suggested list price of $298. Included in the package are a light pen and holder, an external interface, cables, light-pen drivers, Microsoft Pen Extensions for *Windows* Release 1.0a and documentation. System requirements are DOS 3.1 or later, *Windows* 3.1, a 286 or later microprocessor and VGA or higher video card.



Installing It

The hardware consists of the light pen, a PXL-780 external interface box and several cables. The light pen is about the size of a normal pen and has approximately 2½ feet of coiled cable extending from it. It terminates in a phone-jack type connector. The interface is simply a rectangular-shaped box with approximate dimensions of 6¾"D x 3¼"W x 1"H. At the rear of the interface are 15-pin male DIN and nine-pin female DIN connectors.

You start installing the hardware by connecting the light pen to the front of the interface (Fig. 1). Then you connect the included cables from the rear of the interface to the computer and video monitor. It's interesting to follow the path of the cables. As shown in Fig. 2, the DB-9 cable travels from the interface box to the video adapter and then to the monitor. As shown in Fig. 3, the DB-15 connector has two cables that travel from the interface box. One connects to the keyboard, the other to the keyboard port on the computer.

To get the light pen to work, you first need to install FTG's Light Pen Support Software Release 3.31. This is done through a program called PXLSETUP, which loads a file called PXL-BIOS.COM, a memory-resident driver. During installation, you need to calibrate the light pen for DOS applications. Four lines are displayed, one line at a time at each edge of the screen. You press the pen to each line to calibrate the pen. Lines are displayed for each adapter mode; so you need to repeat the process several times. PXLSETUP also modifies *Windows* to use a light pen as the mouse device.

When you start *Windows*, the calibration program automatically loads so that you can calibrate the light pen for use in *Windows*. Once you complete this step, *Windows* starts and you can use the light pen just as you would a mouse. The difference is that the pointer follows the light pen wherever it goes on the screen. To simulate clicking the left button of the mouse, you press the pen against the screen.

Since there are no buttons on this particular pen, you can't simulate the right button of the mouse. Instead, a floating icon appears on the screen with a B and an R side by side. To simulate pressing of the right button, you first press on the R and then press on the screen in the appropriate place. The B simulates pressing both mouse buttons. Alternatively, you can use the Alt key on the keyboard as the right mouse button and the Ctrl key for both buttons. Interestingly, the light pen doesn't defeat the mouse. Therefore, you can use either input device, though not both simultaneously.

The power of the light pen increases dramatically when you install Microsoft Pen Extensions for *Windows* Release 1.0a. For example, Pen Extensions provides both handwriting recognition and the ability to write in electronic ink on the screen. You install this software like most *Windows* programs, by typing A:INSTALL at the Run command of either the Program Manager or File Manager. FTG's Pen Extensions support a variety of display adapters, including VGA, SVGA, 8514/A, XGA and others. I

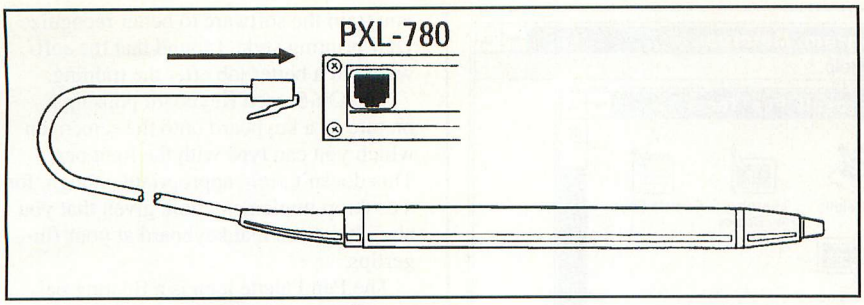


Fig. 1. You start installing the hardware by connecting the light pen to the front of the interface.

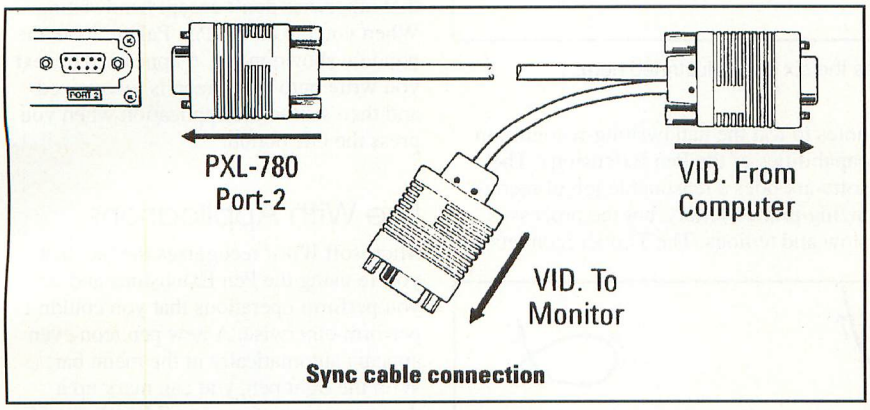


Fig. 2. A DB-9 cable travels from the interface box to the video adapter and then to the video monitor.

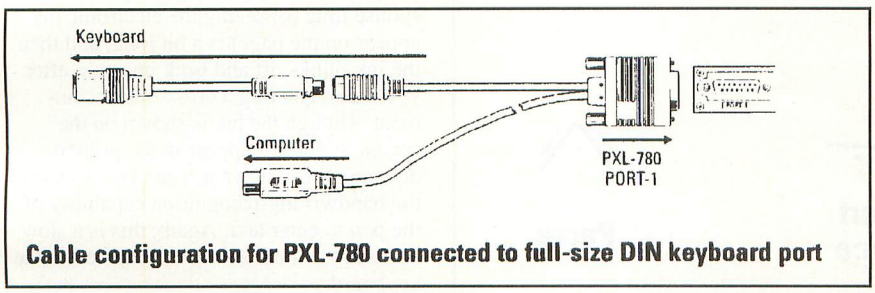


Fig. 3. A DB-15 connector has two cables that travel from the interface box. One connects to the keyboard, the other to the keyboard port on the computer.

used an ALR/Paradise display adapter running in Super VGA mode at 16 colors, which is supported by the FTG package. If you're running more than 16 colors, you may have to obtain a driver that's compatible with the Pen Extensions from the manufacturer of your adapter.

Using the Light Pen Tools

At this point, I had completed the installation without encountering any problems and was ready to try out the light pen. The first thing I noticed when I started up *Windows* with Pen Extensions were thick borders around each window on the screen. This feature, controlled by an entry in the WIN.INI file, apparently makes it easier to adjust window size with the light pen.

The next thing I noticed was a new window group called Microsoft Pen Tools. This window has six icons: Learning Pen Basics, Notebook, Pen Palette, Sample Form, On-Screen Keyboard and Trainer (Fig. 4). Of all the information in Learning Pen Basics, the most useful is the description of "gestures." These are editing-type symbols that let you perform certain functions with the pen that you normally need a keyboard or mouse to do. A gesture reference chart is shown in Fig. 5.

Of the other icons, the Notebook is the most interesting. It's a notebook/calendar type application that takes advantage of the electronic ink and handwriting recog-

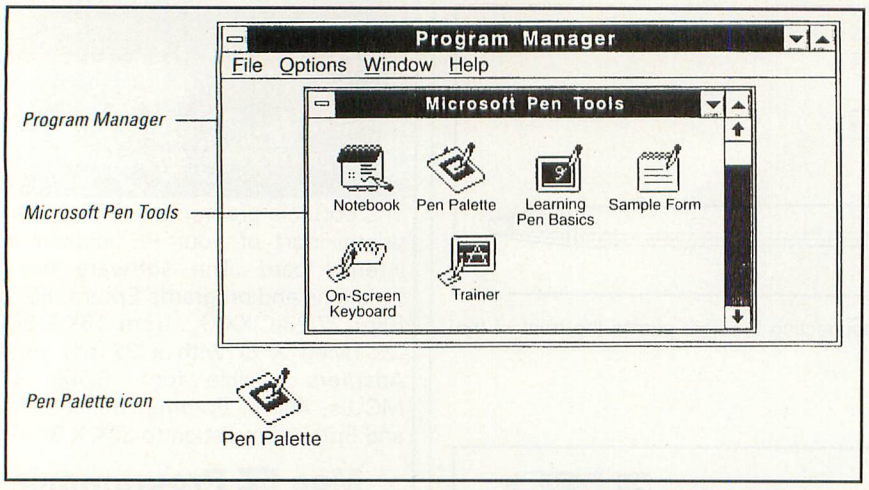


Fig. 4. A Microsoft Pen Tools window group has the six icons illustrated here.

nition features of the light pen. It's similar to the kind of applications you find on PDAs like the Tandy Zoomer.

The Sample Form icon gives you an opportunity to enter a name, address and notes to test the handwriting-recognition capabilities of the Pen Extensions. The software does a reasonable job of recognizing printed letters, but the process is slow and tedious. The Trainer icon lets you train the software to better recognize your printing style. I found that the software did a better job after the training.

The On-Screen Keyboard pops up a picture of a keyboard onto the screen, on which you can type with the light pen. This doesn't seem appropriate, though, for a desktop implementation, given that you already have a real keyboard at your fingertips.

The Pen Palette icon is a floating palette of writing tools that are available whenever you start *Windows* for Pen Computing. You can use the Pen Palette with any application, but its primary purpose is to help you write in applications that otherwise don't accept handwriting. When you tap on the Pen Palette icon, the window shown in Fig. 6 appears. The text you write onto this screen is recognized and then sent to the application when you press the OK button.

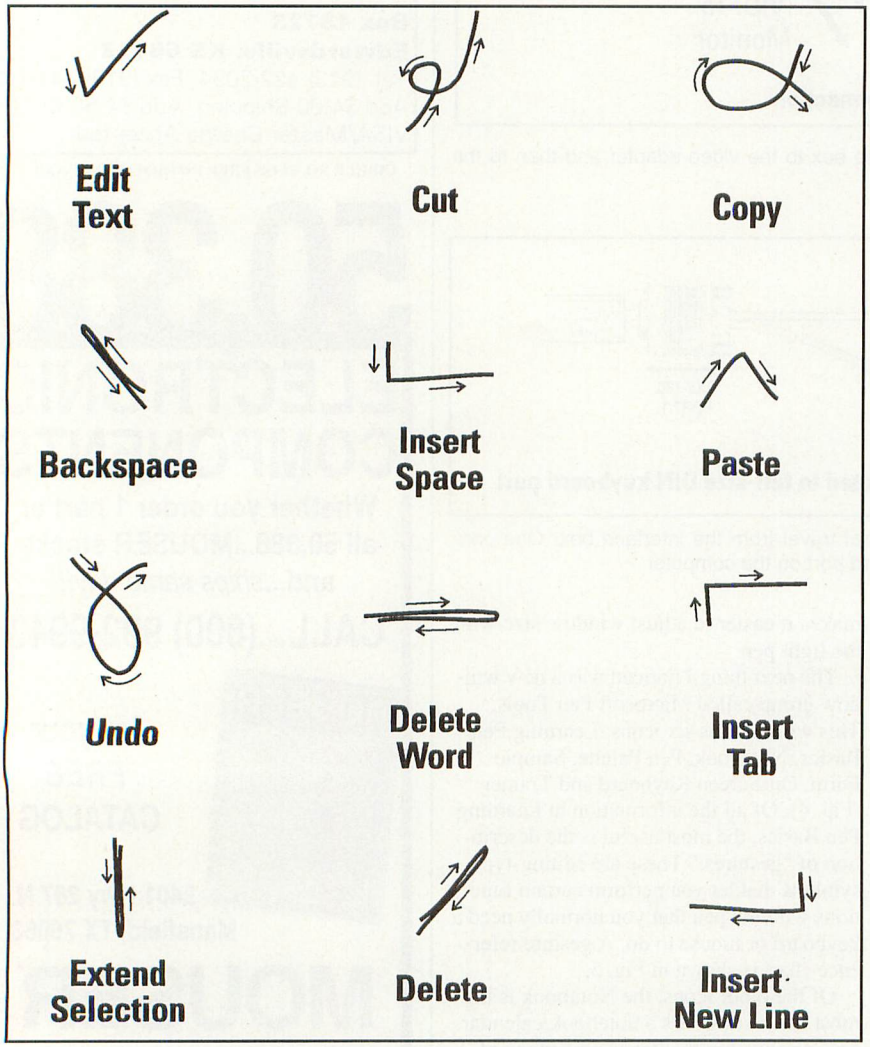


Fig. 5. A gesture reference chart.

Use With Applications

Microsoft *Word* recognizes the fact that you're using the Pen Extensions and lets you perform operations that you couldn't perform otherwise. A new pen icon even appears automatically in the menu bar. With the light pen, you can mark up a document, just as you would with an ordinary pen on a piece of paper. That is, you can make cross-outs, put comments in the margins, etc. In practice, though, the response time (of seeing the electronic ink appear on the page) is a bit long, and then the ink blinks off and back on again after you finish entering a cross-out or comment. Though the ink is shown on the screen, it doesn't appear in the printed document. If you want, you can also use the handwriting-recognition capability of the pen to enter text. Again, this is a slow and tedious method when compared to the keyboard.

One other thing you can do in *Word* and other *Windows* documents is take advantage of a feature called Note-It. This lets you embed hand-drawn or typed notes into a document, providing the application supports embedded objects. A Note-It window is shown in Fig. 7.

Up to this point, I couldn't really see the value of the light pen. Neither handwriting recognition nor electronic ink are sophisticated enough to be big selling points. However, I began to see how the light pen could be put to good use when I tried it with *CorelDRAW* and *Windows* Paint. The light pen is much better than the mouse for drawing. Unlike a tablet, you can draw directly on the screen. Though I'm not an artist, I could see that the light pen affords much better control than does a mouse and makes drawing a much more natural experience than does a tablet.

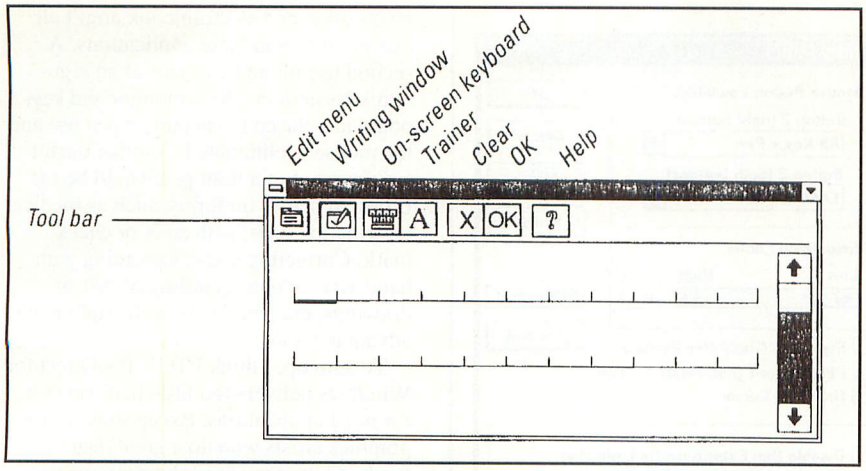


Fig. 6. When you tap on the Pen Palette icon, the window shown here appears.

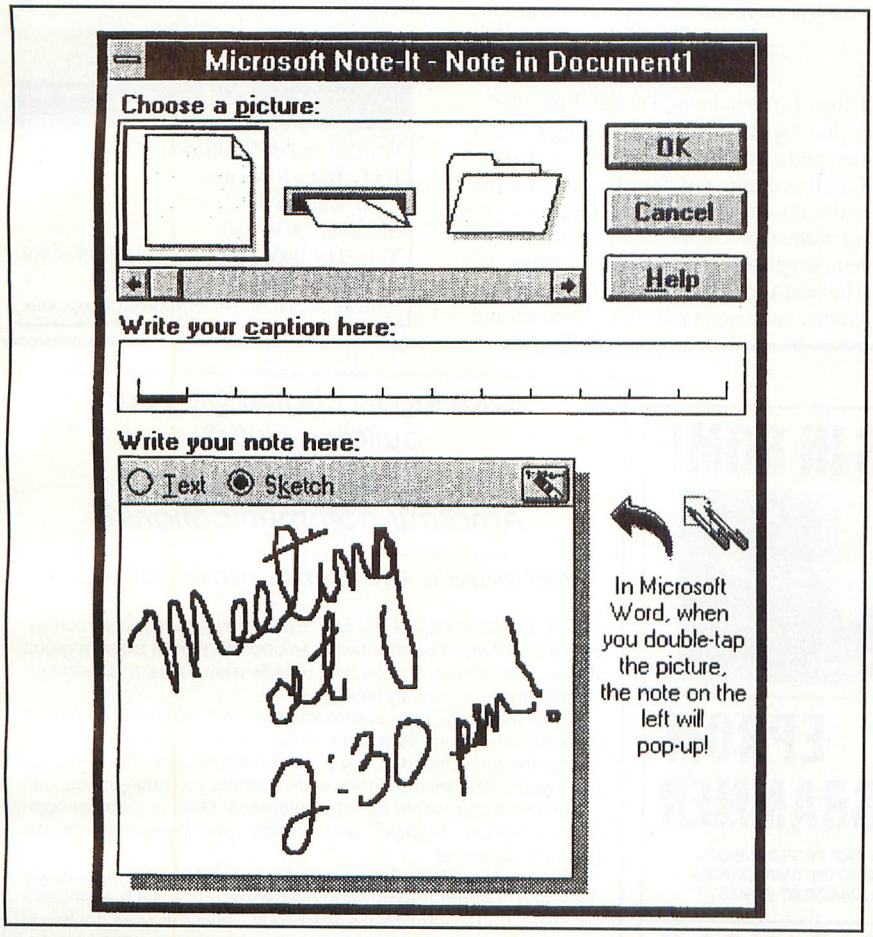


Fig. 7. A Note-It window lets you embed hand-drawn or typed notes into a document, providing the application supports embedded objects.

After most of the testing was done, I decided to try a sample application included in the package called LYRIQ Crosswords Puzzles for PenDirect. In this application, a crossword puzzle appears on-screen and you print in your answers with the pen, just as you would do with a traditional puzzle. The software then recognizes the handwriting. If you want, you can even turn on a feature that lets you know when you've entered an incorrect letter. I found this to be a very entertaining application for the light pen.

If you find that the light pen is not working to your satisfaction, there are plenty of adjustments you can make. When you install the Pen Extensions, four pen icons are added to the *Windows* Con-

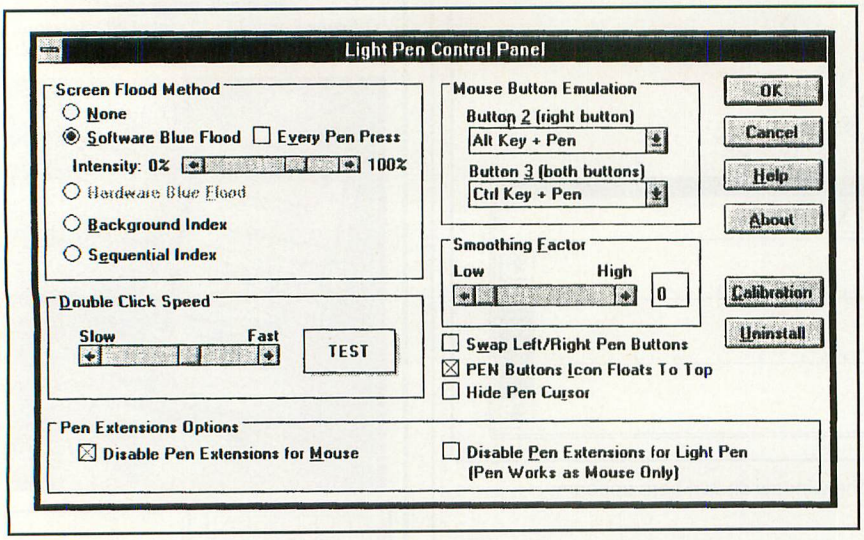


Fig. 8. The Light Pen Control Panel lets you control double-click speed, among other things.

trol Panel. These let you adjust various light-pen parameters. For example, the Light Pen Control Panel lets you control double-click speed, among other things, as shown in Fig. 8.

User Comments

I have mixed feelings about FTG's PenDirect for Windows. Though I like the technology and find handwriting recognition and electronic ink appealing, I also find that these aren't very practical, especially on a desktop system. I tried to come up with some compelling uses for this system, especially since its cost is rather dear. The best use, I think, is with drawing programs, keeping in mind that handwriting recognition and electronic ink aren't all that important in these applications. A second use might be as part of an ergonomic system in which monitor and keyboard are placed to encourage pen use and the mouse is eliminated. Another useful employment of a light pen would be for filling in blanks on forms, such as medical information ones, with an X or check mark. Correcting and commenting with hand-written notes, *circling of text* or drawings, etc., might show the light pen to advantage, too

To sum up, I think FTG's PenDirect for Windows delivers too little performance for most applications. Exceptions are for graphics artists who do a great deal of freehand drawing in such programs as *CorelDRAW* and *PC Paintbrush* or to provide information on forms that require much check-offs in boxes. ■

Product Tested

PenDirect For Windows, $298
FTG Data Systems
8381 Katella Ave.
Stanton,CA 90680
Tel.: 714-995-3900; fax: 714-995-3989

CIRCLE NO. 141 ON FREE INFORMATION CARD

LogicLab Explorer: A Software-Simulated Digital Circuit Breadboard

By Tom Fox

LogicLab Explorer is a neat program that simulates the Wire Wrap technique of breadboarding numerous digital circuits. In its "parts cabinet" are nearly 70 digital IC devices (mostly 74LS-series plus several CMOS and one 555 timer), a practically unlimited quantity and variety of resistors and capacitors, along with DIP switches, a clock source and a huge supply of red LEDs and seven-segment indicators. Simulated tools include a 16-channel logic analyzer that has a timebase that ranges from 1 ns to 500 ms and a buffer size up to 1,024 samples, a hand-held logic probe, Wire Wrap gun and a wire cutter. The simulated board itself is huge, measuring a very generous 25" X 25"! Also available are online data sheets for all ICs in the parts cabinet.

LogicLab Explorer comes with software on both 720K 3½" and 1.2M 5¼" media, though the manual states that it comes with one 720K 3½" disk and two 360K 5¼" disks. Included is a fairly well-written 34-page manual that has an abundance of screen shots. While actual print quality of the text could be improved, it's readable. However, the same can't be said about the screen shots, which are of poor quality. The manual lacks an index, but it has a good table of contents.

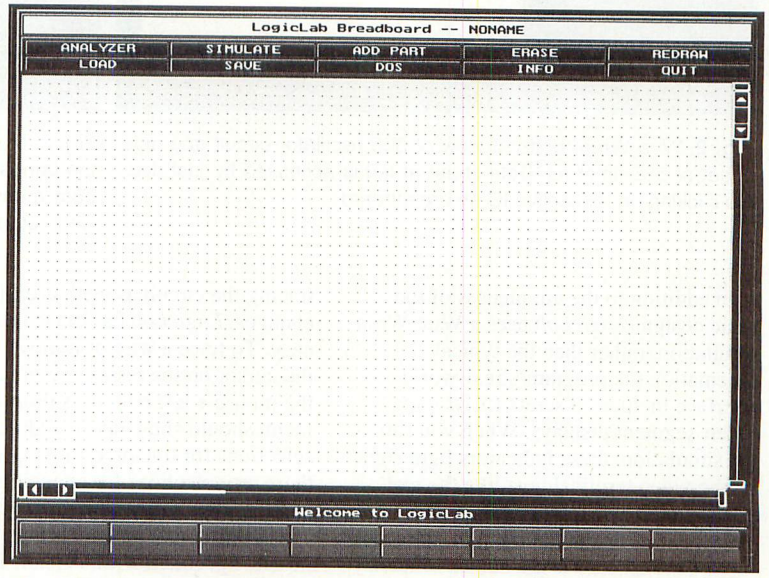


Fig. 1. LogicLab Explorer's Breadboard screen.

Installation

Since this software requires less than 900K of disk space, it can be installed on a high-density floppy disk. Nonetheless, more typically, it will be installed on a hard disk. The installer used by *LogicLab* is professional in appearance and proceeded without a problem. The default installation directory is C:\LLAB. I easily changed this default to D:\LLAB. (I have more room on my D: drive than I have on my C: drive.) As you can tell from the screen shots, *LogicLab* uses a Graphical User Interface (GUI). Even the Installation screen seems to use this GUI.

Trying It Out

This is a relatively simple program. So unless you're completely new to computers, you don't have to study the manual before trying it out. Nonetheless, a bit of studying never hurt anyone!

The first step in using *LogicLab* is to draw a rough sketch of the circuit you want to try. Typically, this sketch is a schematic representation of the circuit. Make sure the parts used in the sketch are contained in *LogicLab*'s library. Either check out the list of parts on the back of the box or, more appropriately, determine the types of parts from the INFO menu, which is accessed from the Main breadboarding screen.

After starting *LogicLab* by simply typing LOGICLAB at the DOS prompt, the first screen that shows up is a portion of a cleared breadboard. This is referred to in the manual as the Breadboard Screen and is shown in Fig. 1. The next step is to start adding parts. Here simply click the ADD PART button at the top of the screen. This button starts a series of menus that let you select a part to be installed on the screen. Use this button to place all your parts.

After you've installed all parts on the board, you "wire" together the parts with a Wire Wrap gun. You do this by pointing to a pin with the cursor and then pressing and holding the left mouse button. After a second or so the cursor changes into a Wire Wrap gun. Then just move this gun to the other pin to which you want to connect and let go of the mouse button to make the connection, as shown in Fig. 2. It's all very simple and fun, really. One caution here. You're working on the bottom side of the board and the pin connections are upside down. *LogicLab* color codes the supply leads for clarity – red for + and green for ground. Since all supply leads are automatically connected to a power source, there's no need to connect them. (Actually, no separate power source is supplied. Nonetheless, you can use the supply leads on the IC as a source if you need the power for something unique, as will be demonstrated shortly.)

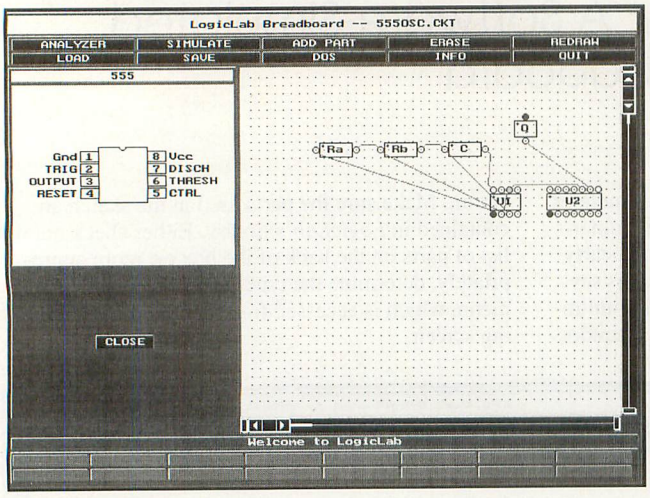


Fig. 2. Wire Wrap (bottom) view of 555 oscillator circuit and data sheet of 555 timer IC. Data sheet at left is accessed by just double-clicking on respective IC on breadboard.

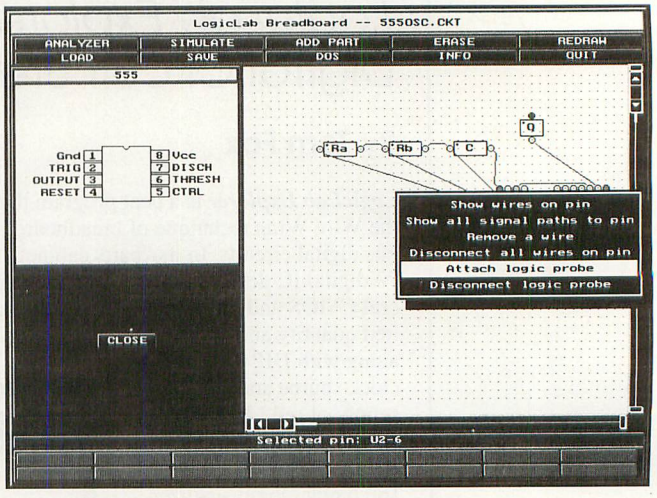


Fig. 3. Mouse cursor on pin 6 of *U2*. Single click of left mouse button brings up drop-down menu. Select "Attach logic probe" option from menu, and Logic Probe #2 is then attached to pin 6 of *U2*. Color of selected pin 6 of *U2* changes from white to pink.

In addition to the uniqueness of the basic design (*LogicLab* uses a Wire Wrap simulation, rather than the typical schematic), the program's real-world interface includes discrete LEDs and seven-segment displays. When you run the simulation, these indicators light right on the video terminal, just like the real thing.

Of course, one of the main reasons for using a breadboard is the human tendency to error. If a design circuit works exactly the way the designer envisioned there are only three possibilities: (1) the designer "borrowed" the design from someone else who already tested it out, (2) the circuit was trivial or (3) the designer was really lucky! Because of this profound truth, it's imperative that there must be ways of tracing the circuit as well as easily making changes. *LogicLab* has made this task easy. To trace a wire or remove it, place the cursor on the respective pin and click the mouse's left button. A drop-down menu should show up. In addition to menu selections for tracing/removing wires, there are selections for attaching/disconnecting logic probes, as shown in Fig. 3.

This drop-down menu brings up a slight possible problem with Version 1.0 Release 3 of *LogicLab*. The designers are already aware of this possible problem and are probably working on it. The problem has to do with some erratic response of the mouse when old Mouse Systems mouse drivers are used. For instance, when I used a 1990 Mouse Systems driver and first started *LogicLab* after booting up and wanted to remove a wire, clicking the left mouse button, the mouse didn't always seem to bring up the drop-down menu as it should. I had to fiddle a bit with it. However, after a short period of use, this problem disappeared. It's a bit strange, and sometimes annoying, but it's something you can work around and presents no real problem since it disappears even faster than my computer's free hard disk space.

Smoke Test

Power here is applied by clicking on the SIMULATE button. No need to worry about any smoke or flames. The designers of *LogicLab* apparently left this simulation out. Oh well, it would have been a fun touch.

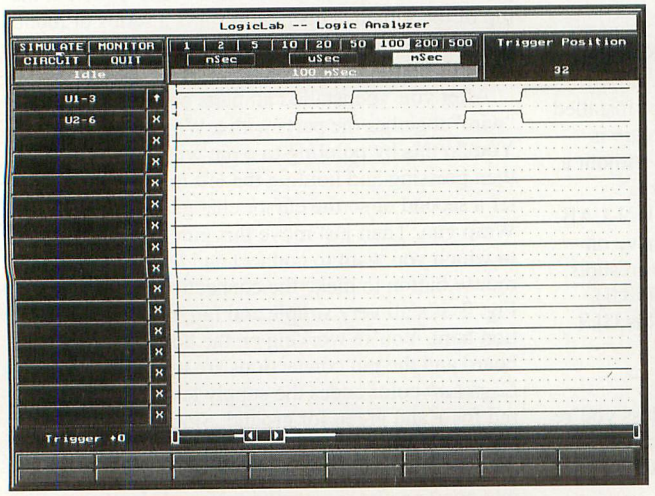


Fig. 4. Click on SIMULATE button and screen changes to top side view in which no wires are shown since they're on the bottom of the board. LED flashes red on a color display. Click on the STOP button to return to Wire Wrap board.

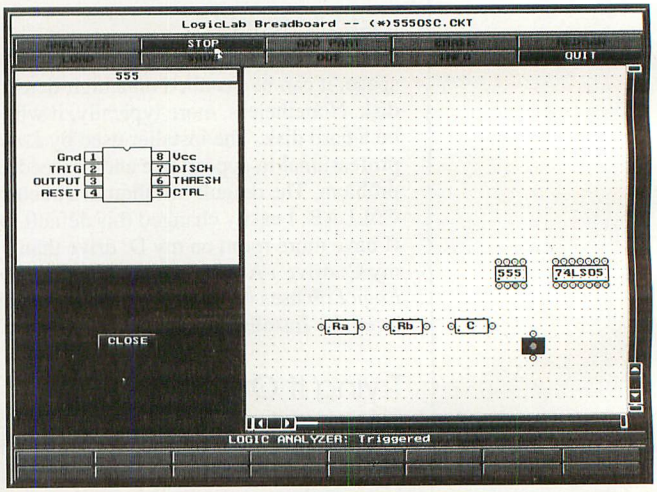


Fig. 5. Clicking on ANALYZER button for Logic Analyzer screen shows up with logic probes 1 (*U1* pin 3) and 2 (*U2* pin 6) showing a signal, while other channels show nothing since they aren't connected to the circuit.

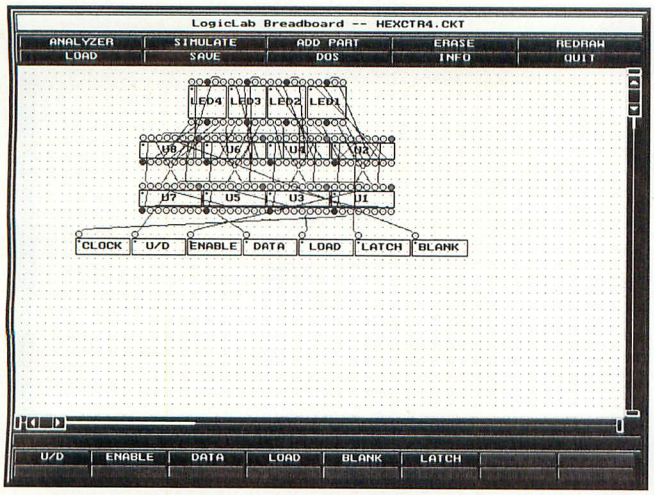


Fig. 6. Breadboard of sample circuit HEXCTR4.CKT.

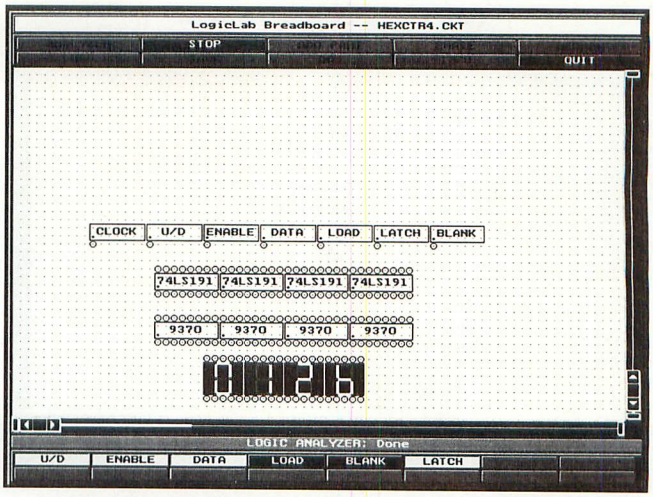


Fig. 7. Simulation of sample circuit HEXCTR4.CKT. Note seven-segment displays.

Again, don't become confused. While the circuit is running (simulation mode), the screen shifts to the top side of the board, pins change location and the wires disappear. They're now "beneath" the simulated board.

If your circuit doesn't have any indicators—LED or seven-segment—nothing will seem to be taking place. Of course, you can use a hand-held logic probe to see some results, but a better way is to use the logic analyzer. Here, you'll have to connect logic probes to at least one pin. Since it is a 16-channel logic scope, you can observe voltages on 16 different pins at the same time. To display the logic analyzer simply click on the ANALYZER button. Several options are available to you with the logic analyzer, including setting the timebase (Fig. 4).

LogicLab includes a number of sample circuits. To try one of these out, click on the LOAD button and then select one of the descriptive file names. Figure 2 shows the Wire Wrap side of the 555OSC.CKT sample. To apply power to this circuit, you click on the SIMULATE button. Before doing this, however, you want to attach a logic probe to pin 6 of *U2*. (Logic Probe 1 is already attached to pin 3 of *U1*.) You do this by placing the mouse cursor on the pin and clicking the left mouse button. From the drop-down menu (Fig. 3), you select the "Attach logic probe" option. The color of the selected pin changes from white to pink to mark the attachment of the logic probe.

Now you apply power by clicking on the SIMULATE button, at which point, the screen changes to the top-side (component-only) view. No wires are shown since they're hidden by the board. The LED on the board flashes red on a color display. See Fig. 5. Click on the STOP button to return to the Wire Wrap side.

To use the logic analyzer, click on the ANALYZER button to make the logic analyzer screen show up. Notice from Fig. 4 that only the first two channels display a signal. The other channels aren't attached to the circuit.

Figures 6 and 7 show the breadboard view and simulation of a fairly complicated sample circuit—HEXCTR4.CKT. Notice the real looking seven-segment display.

Limitations

I found that *LogicLab* did a good job in fulfilling its claims. But don't get the idea it does more than it claims! While *LogicLab* successfully simulates many ideal digital circuits, it can't be used in place of an actual breadboard for all circuit schemes. From my testing of *LogicLab*, it's pretty obvious that this software package doesn't do analog simulation at all. I first got a

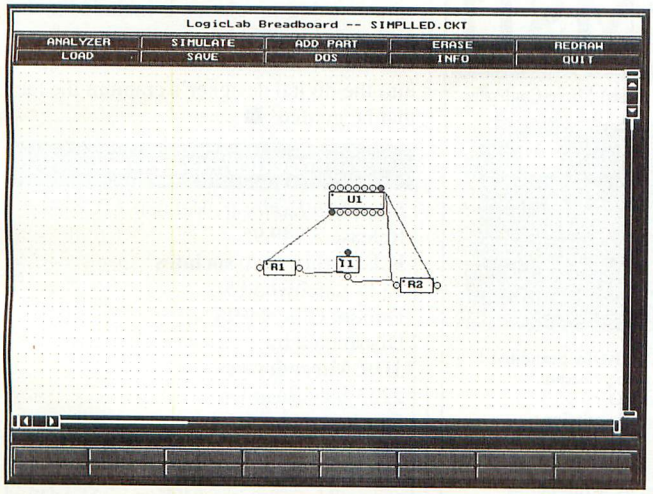


Fig. 8. Simple LED circuit that isn't simulated properly by *LogicLab*. This circuit demonstrates *LogicLab*'s limitation that it doesn't perform properly with analog circuits.

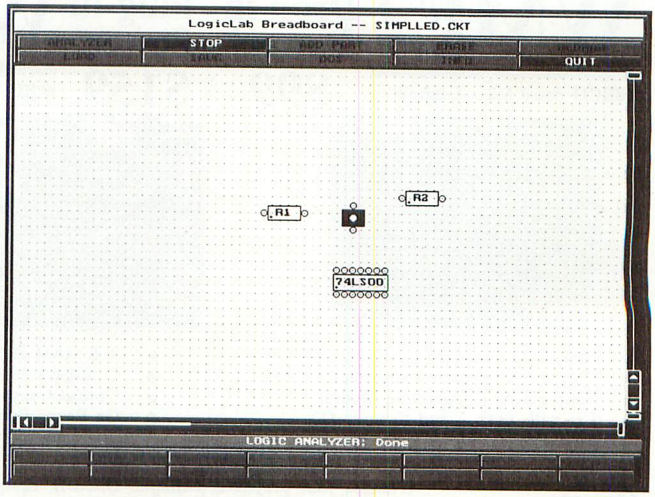


Fig. 9. Simulation of simple LED circuit. Note that even if *R2* has a value of 1 ohm, the LED doesn't light (a dark LED shows up as dark gray on the screen shot).

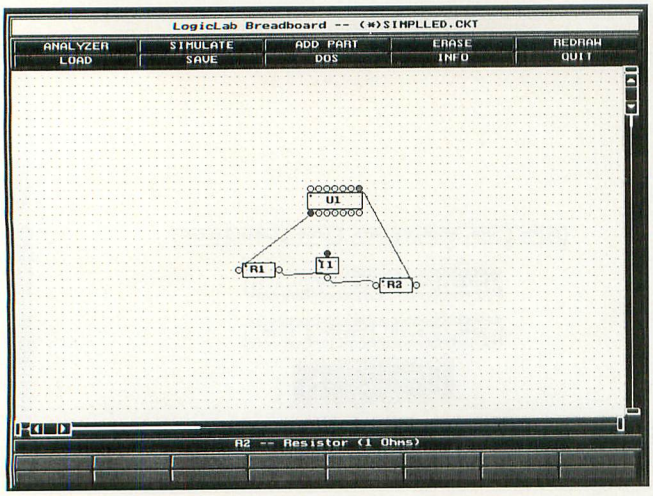


Fig. 10. This circuit is similar to the one shown in Fig, 8, except that a wire jumper is used to short out *R2*.

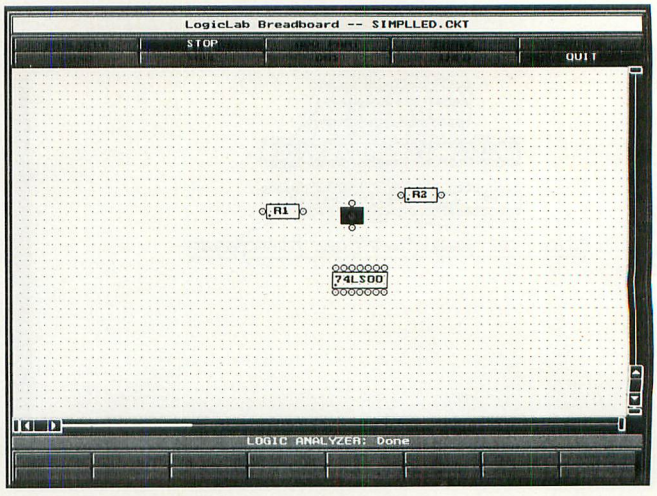


Fig. 11. Simulation of Fig. 10 circuit. LED now lights (bright red shows up nearly white on the screen shot).

hint of this when I attempted to simulate a basic inverter-based oscillator. *LogicLab* didn't show any oscillation whatsoever!

To check the foregoing out further, I attempted to simulate a simple LED circuit, shown in Fig. 8. Notice that power for this simple LED circuit was taken off a 74LS00 IC. The 74LS00's sole purpose in this circuit is to serve as a roundabout power source. Notice that *R1* in this circuit has a value of 1,000 ohms while *R2* has a value of 1 ohm. Also notice that the LED's anode is automatically connected (by *LogicLab*) to a positive voltage source. Figure 9 shows this circuit when simulated. The LED is dark and doesn't light at all. In Fig. 10, I replaced 1-ohm resistor *R2* with a wire. (Though I'd hoped *LogicLab* was smarter than I figured, the LED blew since *R2* was only 1 ohm!) As you see in the simulation shown in Fig. 11, the LED now lights. Real life ain't nothin' like this!

I realize the technical difficulty with the simulation of both digital and analog circuits with a single program. However, I'm sure it can be done and this would add greatly to a program such as *LogicLab*.

Personally, I like the relative simplicity of *LogicLab*. I'm not fond of some software that contains every possible esoteric feature, even though it's rarely, if ever, used. Saying this, I feel a bit hypocritical in starting a wish list for *LogicLab Explorer*. Blushing as I state the following, I wish *LogicLab* included a simple schematic-drawing program with in the basic package. Such a feature would be useful to some of us whose minds work better when viewing at a schematic diagram than a Wire Wrap board. If a schematic-drawing program were to be included in *LogicLab*, it would supplement the Wire Wrap board, not take its place.

User Comments

LogicLab Explorer 1.0 Release 3 is one of those "fun" programs that you wished did more than it claimed. It's an excellent program for someone who wants to learn the basics of digital-circuit design, as well as the actual breadboarding and testing of digital circuits. The modest $50 cost of the program is quite reasonable when you consider that it would cost many times this much to assemble all the parts and tools for the real thing.

As it stands now, *LogicLab Explorer* is a good program for hobbyists but not for someone who is seriously interested in designing circuits. This could change if accurate analog simulation is included in the package. Also, I'd love inclusion of the simulation of smoke and flames to blazon into the digital designer's cranium the fact that he goofed! ■

Product Reviewed

LogicLab Explorer, Version 1.0, Release 3 $49.95
K.E. Ayers & Associates
7825 Larchwood St.
Dublin, Ohio 43017
Distributed by
JDR Microdevices
2233 Samaritan Dr.
San Jose, CA 95124
Tel.: 800-538-5000
Minimum Requirements: PC/XT or AT (or compatible) computer, 640K of RAM, DOS 3.2 or later, EGA or VGA, mouse.\

CIRCLE NO. 138 ON FREE INFORMATION CARD

By Joe Desposito

Computing on the Go

Putting Together a Workgroup for Peanuts and a Great Buy on an Active-Matrix-Display Ultra-Portable PC

A couple of computer superstores—CompUSA and Computer City—have opened in my area recently. Naturally, I feel compelled to visit each of them at least once a week and browse through the aisles. Inevitably, I'll find a product that's priced so low that I have to purchase it. This was the case several weeks ago, when I came across a combo network adapter priced at $29.99 in CompUSA.

I'd been mulling over the idea of putting together a three-person workgroup in my office, using two PCs and a notebook. I wanted to use *Windows for Workgroups* 3.11 to connect together the three computers, since I'd been reading such splendid reviews about this product. It was my understanding, from my reading, that *Workgroups* 3.11 speeds up a system due to its ability to provide 32-bit disk and file access. Also, from my reading, *Workgroups* 3.11 appeared to be a good choice for connecting together a small network. The problem for me was the cost.

To put together a three-person workgroup with two desktop PCs and a notebook PC, you need two network adapter cards for the PCs and one network connector for the notebook, either a PCMCIA LAN adapter or a pocket LAN adapter. Then you need a copy of *Windows for Workgroups* for each system. Finally, you need to decide on the wiring. The two possibilities that make the most sense to me are 10Base-T and 10Base-2.

Let's go over the costs first. If you already have *Windows* on your PC, the *Workgroup Add-On for Windows* costs about $50. Factoring in the cost of the Linksys Ether16 LAN Card combo adapter gives you a total of $80. This is the cost for each PC. The cost to include the notebook in the mix is a bit more tricky to figure out.

I found a PCMCIA ethernet adapter manufactured by a company called MaxTech for $99 in CompUSA. Unfortunately, it was for 10Base-T only and not a combo adapter. The next lowest price was for another product from Linksys called the Combo PCMCIA EthernetCard. This costs $169.99. Thus, adding the notebook PC to the workgroup costs about $220.

An alternative to the PCMCIA ethernet card for the notebook is a pocket ethernet adapter. Surprisingly, though, Xircom's Pocket Ethernet Adapter III for 10Base-2 costs a whopping $280 in CompUSA, a price I wasn't willing to spend.

I found a lower-priced alternative from a company called Silicom Direct (tel.: 800-4-SILICOM) advertised in a computer magazine. Its pocket ethernet adapter for 10Base-2 is advertised for $139. I saw the ad, however, after I purchased the Linksys PCMCIA card. In truth, though, for the $30 difference, I prefer a PCMCIA ethernet card over a pocket adapter.

You may be wondering why I didn't purchase the $99 PCMCIA ethernet adapter. As I stated, this one was a 10Base-T ethernet adapter. A 10Base-T setup is convenient because it uses twisted-pair wiring with RJ-45 modular plugs that are similar to the connectors used for ordinary telephone wiring. The problem, though, is that you're forced to purchase an additional item called a hub. An eight-port 10Base-T hub sells for about $150. Thus, purchasing the $99 card would have added an additional $150 to the cost for the hub alone. If you do the math, the hub becomes cost effective if you have three notebook stations in the workgroup, though.

Now that I've covered the costs of the major components, let's take a look at the costs associated with the wiring. A 10Base-2 ethernet network uses thin RG/58 coaxial cable, at each end of which is a BNC connector. A 50-foot length of this cable, with connectors, costs about $22. Alternatively, you can make the cable yourself, if you have the skill to do so. In this case, the cable has a per-foot cost, depending on how long a roll you buy, and the connectors have a per-connector cost of about $1 each. Suffice it to say that a 50-foot cable costs about $10 if you make it yourself.

A 10Base-2 network also demands a T connector for each station, which is usually included with the adapter card. Finally, you need a 50-ohm terminator on each end of the network, at a cost of about $2 per connection.

In this case, I linked up three computers in the office. At one end was a 33-MHz Toshiba T3400CT ultra notebook computer with 4M of RAM. On the other end was a 40-MHz 80386 clone computer with 8M of RAM. In the middle was a 25-MHz 80486 ALR PowerFlex with 4M of RAM. The two PCs were about 70 feet apart, while the T3400CT notebook was about 40 feet from the ALR. Total cost of the wiring came to about $25.

That's it for the costs associated with connecting together this three-person workgroup. Let's now take a look at the installation. The first thing I did was install *Windows for Workgroups* 3.11 on the ALR. I immediately hit a snag. The installation process, which requires eight disks, got stuck at Disk 5. For some reason, the computer couldn't read the disk. I aborted the process and tried again.

Now recall that I was installing the *Workgroup Add-On for Windows*, which is really an upgrade product. As an upgrade product, it requires that you have a previous version of *Windows* on your system, which I had. But when I tried to load the program a second time, I received an error message. The gist of the message was that I couldn't use the add-on version. I needed a full-blown copy of *Windows for Workgroups*. In other words, the aborted first attempt had blown away all traces of the previous version of *Windows*. I couldn't figure out how to get around this problem. So I called Microsoft technical support.

The technical support person with whom I spoke gave me the solution to the problem. First I had to copy WINVER-.EXE to the root directory, and then I had to remove the following statement SetupState=1 from the WIN.INI file. After doing this, I once again attempted to install *Workgroup Add-On for Windows*. This time, the installation went well, and there were no further "read" errors.

After installing *Workgroups* on the ALR, I installed the Ether16 LAN card. This is a fairly easy process. The main thing to watch for is the IRQ and I/O address you assign to the card. Unfortunately, I didn't watch this point carefully enough and had to pay the price for this oversight later.

After installing the adapter card, the next step was to perform the network setup in *Windows for Workgroups*. The icon to do this is in the Network group window. This is a straightforward process in which you choose the network driver, among other things. In this case, I chose one of the listed drivers: NE2000 Compatible. I also set the IRQ and I/O address to match what I'd set on the adapter card.

After making all these changes, *Workgroups* needs to shut down and restart. When this occurred, *Workgroups* didn't restart. Instead, it hung. Not sure how to proceed at this point, I re-booted and tried starting *Workgroups* with the /b option. This creates a bootlog file in ASCII text that tells you why *Windows for Workgroups* won't start. When *Workgroups* failed to start again, I re-booted.

When the DOS prompt appeared, I used the DOS editor to examine the BOOTLOG.TXT file. I found a few lines that showed where the start-up procedure had failed. All failures were network-related. Since I didn't know how to fix the problem, I called Microsoft technical support again.

The first thing the support person told me was to start *Workgroups* with the /n option. This lets *Windows for Workgroups* start without the networking features. If *Workgroups* starts, you know the problem is network-related. *Workgroups* started without a problem. The support person told me to check my system to see if there were any IRQ or I/O address conflicts. I checked and found a conflict. After I corrected this, everything worked fine on the ALR.

Installing *Workgroups* on the 386 clone PC went much better because I was much more careful to note interrupt usage on this machine. When installation was complete, I attempted to share files and a printer between the two machines.

Windows for Workgroups includes enhanced File and Print Managers through which you accomplish all connections. To establish a connection between the two PCs, you must first share a disk, directory or printer on one machine and then connect to it on the other machine. This may sound simple enough, but I misinterpreted the statement.

Sitting at the ALR, I established a shared directory through File Manager and then tried to connect to the 80386 clone. Nothing occurred. After struggling with the documentation for a while, I made another call to Microsoft support. The support person reinforced the "share" then "connect" axiom, but he also added that you share on one machine and then go to the other machine to connect. Once I grasped this concept, everything worked as it should between the two machines.

The final step was now at hand—connecting the Toshiba notebook to the workgroup. To do this, I first had to install the Linksys Combo PCMCIA Ethernet Card. This is a Type II PCMCIA card that can be used with either 10Base-2 or 10Base-T networks. The first installation hurdle is to get the notebook to recognize the card.

I plugged the card into the PCMCIA slot and tried to figure out what to do next. Linksys includes hardware installation instructions in a small booklet and software instructions on disk.

The software installation instructions made reference to a PCMCIA library that might exist on the notebook. I looked for a library on the Toshiba, but I couldn't find one. The next suggestion from Linksys was to use the card and socket services contained on the disk instead of those that came with the Toshiba. I wasn't about to do this. Instead, I took a closer look at the Toshiba.

In the Toshiba Card Manager window, I found an icon titled PCMWin and clicked on it. This gave me the status of the card in the socket, which showed that it hadn't been configured. Configuring it entailed entering the interrupt and I/O address. Sound familiar? After entering the numbers, I re-booted. True to form, *Workgroups* just hung during start-up.

This time, I knew the problem. I re-booted, and then restarted *Workgroups* with the /n parameter. Then I reconfigured the card for a different interrupt. This solved the problem. Now I had everything working. All three PCs were connected together at a cost that I thought was very reasonable.

I'd like to end this column here, but I can't.

After all the work I put into setting up this system, I found out something about *Windows for Workgroups* that didn't quite please me. When I connected together PCs with this product, performance degraded significantly. After reading the reviews, I was expecting an increase in performance, but I was sorely disappointed.

On the ALR, where I often work with *PageMaker*, my hard disk began seeking incessantly. It seemed like I was using a disk-exerciser program. Since the hard disk was constantly seeking, it interfered with operation of my mouse. I clicked on the mouse and got a delayed response. I felt like I was using *Windows* on an 8-MHz 80286 machine!

As for the workgroup functionality, this also proved to be abominably slow. I had hoped that the person on the 80386 clone or Toshiba notebook could work with a file on the ALR machine through the network. This slowed down operations so much that the strategy had to be changed. It was necessary to copy the file from the ALR to the PC or notebook and then work on it. This is a dangerous way to do work and can easily result in two people working on the same file at the same time.

I found this to be so discouraging that I made one more call to Microsoft support to find out if something could be done to improve the situation. The support person asked the usual questions. Did I enable 32-bit disk access? Did I enable 32-bit file access? Not only did I do these things, but I had also installed a *Windows* VGA accelerator card on the ALR to speed up the display. His final comment was that he thought I had reached the limits of my current system!

You may be wondering if the blame for the slow speed should be placed on the low-cost cards I installed in each system. I checked with one of the techs in the office who is using these cards on a Novell network and he tells me that they work fine. I think the blame belongs squarely on *Windows for Workgroups* 3.11. If you need a 66-MHz 486 system with 8M of RAM as a minimal system for *Workgroups* to operate at a reasonable speed, Microsoft should state this on the box *Workgroups* comes in.

I plan to upgrade my PCs in the near future. Maybe this situation will spur me on to do it sooner than later. For now, if I want workgroup functionality, it looks as if I'll have to implement strategies that will cause the least amount of slowdown to each system.

Affordable Active-Matrix Ultra-Portable PC

Toshiba's Portege T3400CT, which had a list price of $4,398 when first introduced last year, now has a street price that has fallen below the $2,000 mark. I had an opportunity to get my hands on a T3400-CT recently and have found it to be a superb ultra-portable computer (Toshiba has

(Continued on page 100)

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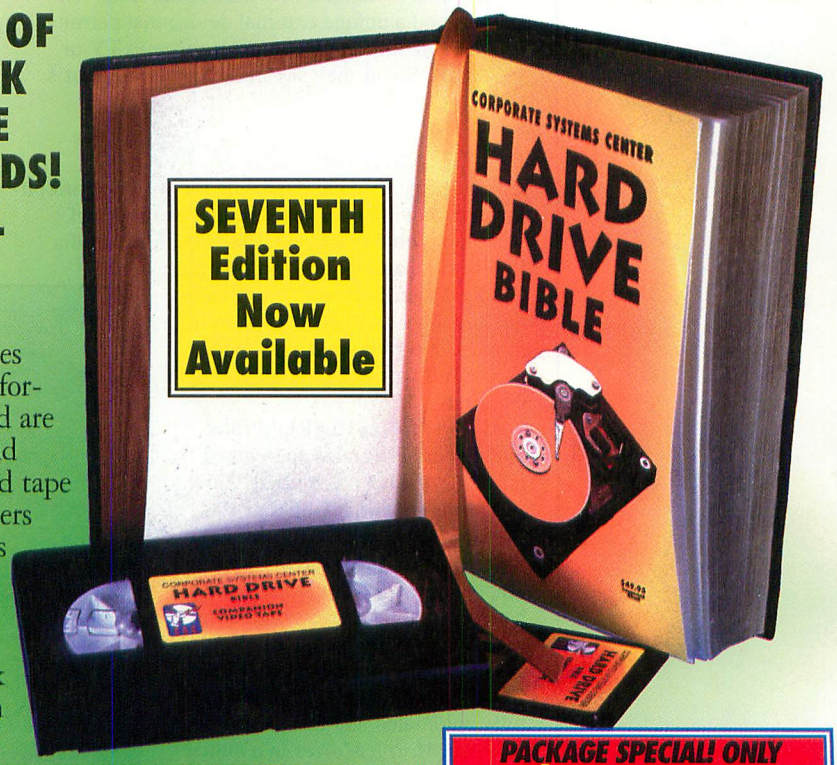

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By Tom Benford

Morphs on CD-ROM and Mixing and Outputting Computer Video to TV or Video Tape

Since morphing and video are the hot topics for this issue, I'll focus on these two here as well. In the mix for this month are two CD-ROMs filled with morphs and a unique external device that permits mixing and outputting computer video to TV or videotape. So, as they say in the movie biz, "let's roll 'em!"

Morph Movies CD-ROM

If you're interested in exploring the world of morphing and viewing some outstanding examples of what's possible in this area, Jasmine Multimedia Publishing has a unique multimedia CD-ROM that's chock-full of *Video for Windows* (.AVI-format) morph movies, still bitmap images, and even a full working copy of Gryphon's *Morph* 1.0.

Morph Movies CD-ROM runs under *Windows* and is segregated into four distinct areas titled "How to Morph," "Morph Gallery," "Screen Saver" and "Morph Tools." Since the user interface is 100% graphical, employing icons that are hot-linked to the corresponding program areas, there's no learning curve to contend with to use this CD-ROM. And since installation is fully automated and fast, you'll be enjoying *Morph Movies* in a matter of minutes after opening the box.

In the "How to Morph" section, you meet Duane Maxwell, the originator of the Gryphon's *Morph* program and Gabriel Wilensky and Michael Peay, two other morphing experts from Gryphon, by clicking on the chalkboard icons representing each individual. Morphing is used throughout the program extensively, beginning with the chalkboard.

As you click on one of the "chalk "drawings of any of these three guys, the chalk image instantly morphs into the video segment on the "projector" screen. Different morphing techniques are used throughout each segment to superimpose titles, captions and examples of what's being explained in the narrative.

Information imparted by these experts and the more than 100 image files and scores of morphed video sequences make this disc well worth the purchase price alone. But much more than this is included.

A fully-functional version of Gryphon's *Morph* Version 1.0 is also provided so that you can get your feet wet in morphing without additional purchase. You can experiment with the different morphing and warping effects, using the images provided on the disc, or you can use your own image files or captures. I used this version of *Morph* for several months before I upgraded to the current Version 2.5 (covered in my feature on morphing elsewhere in this issue). Aside from several new bells and whistles in the new version, the original included on the CD-ROM has plenty of muscle and enough features to keep you amazed and amused for quite a while.

The *Morph* application is in the "Morph Tools" section, along with a photo album of image files you can copy and use for your own morphing/warping projects. A video catalog of other Jasmine multimedia CD-ROMs is also included in this section to give you a brief description and sampling of the company's other titles. Of course, you'll want to upgrade to the latest and greatest version after you get a taste of what you can do with morphing software. A special upgrade offer is included with the disc.

Jasmine Multimedia's *Morph Movies* CD-ROM is a cornucopia of morphing goodies, all of which are accessed from graphic menu screens like the one shown here. In addition to being a treasure trove of information, samples and examples of state-of-the-art morphing on PCs, this ranks as one of the best-produced multimedia CD-ROMs.

In "Morph Gallery" are convenient groupings of all the morph .AVI video files on the CD-ROM, assembled by genre, that include "Art Attack," "Morphin' Folks," "World Leaders on Parade," "Zootopia," "Wings 'n' Wheels" and "Other Neat Stuff." Viewing the movies in this gallery will fuel your imagination and give you some great ideas on things you can do with the included *Morph* software.

Also included is a screen-saver module that adds the capability to display your morph movies (or any

other .AVI file) as a screen saver.

Without doubt, Jasmine's *Morph Movies* is one of the best multimedia CD-ROM values available today. I recommend it highly.

Morphology 101 CD-ROM

Morphology 101 from Andover Advanced Technologies is another *Windows*-based morphing CD-ROM. Andover has taken a different approach to presenting its material but still manages to pack lots of bang-for-the-buck into this less-than-$40 CD-ROM. *Morphology* 101 was the first tutorial/ example CD-ROM available to illustrate and explain morphing, warping and other special-effects techniques for *Windows* users.

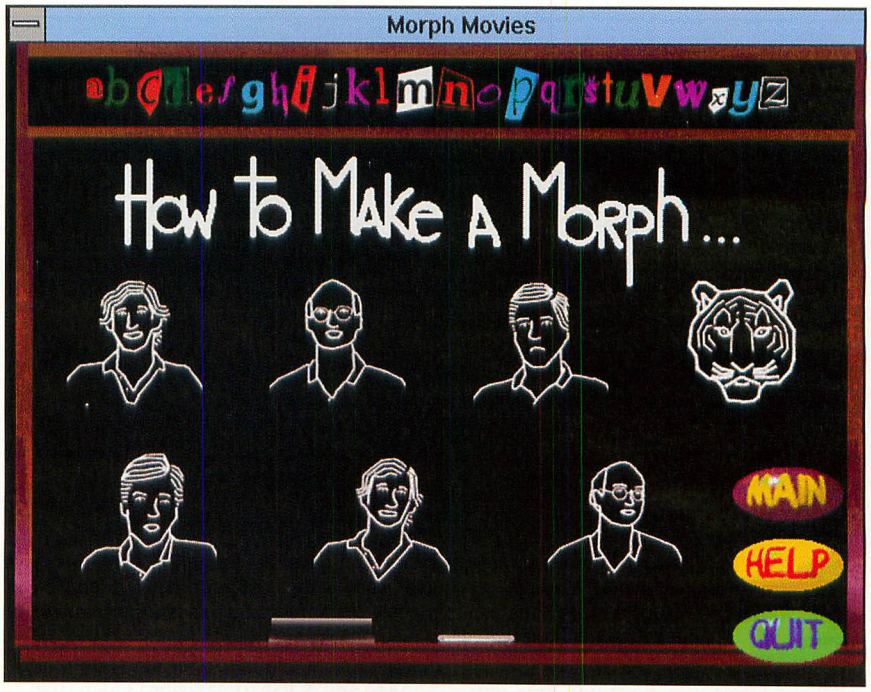
Morphology 101 consists of an interactive on-line *How The Pro's Morph* "manual," a light version of *PhotoMorph Lite* from North Coast Software (*PhotoMorph* 2, the full version of this package, is also covered in my feature on morphing elsewhere in this issue), animation and image galleries and Access Softek's *Matinee Screen Saver*.

At the heart of *Morphology* 101 is its main menu screen that relies on action buttons, rather than icons, to access different areas of the program. Unlike *Morph Movies*, which uses motion video exclusively to provide tutorial material, *Morphology* 101 has a 33 page-*Windows* Write document that includes embedded video segments and graphics to explain the morphing process and techniques. Since this program has been available for more than a year, its understandable why full-motion video, which was in its infancy when *Morphology* 101 was created, wasn't used more lavishly. The information contained in the interactive manual is valuable and well written, nonetheless.

Employing *Windows* OLE capability, more than two dozen pertinent examples using video-clip animations are embedded throughout the text of the document, right where they apply. This makes it possible for you to more easily grasp the concepts and materials presented and provides pleasant diversion from a text-only approach. As with any other Write document, you can also produce a hard copy of it on your printer for off-line reference.

Also provided on the disc are 74 animated sequences, which you can summon via an Animation Gallery button. These sequences provide a diverse assortment of morphing, warping and other special-effects samples you can use royalty-free for your own applications.

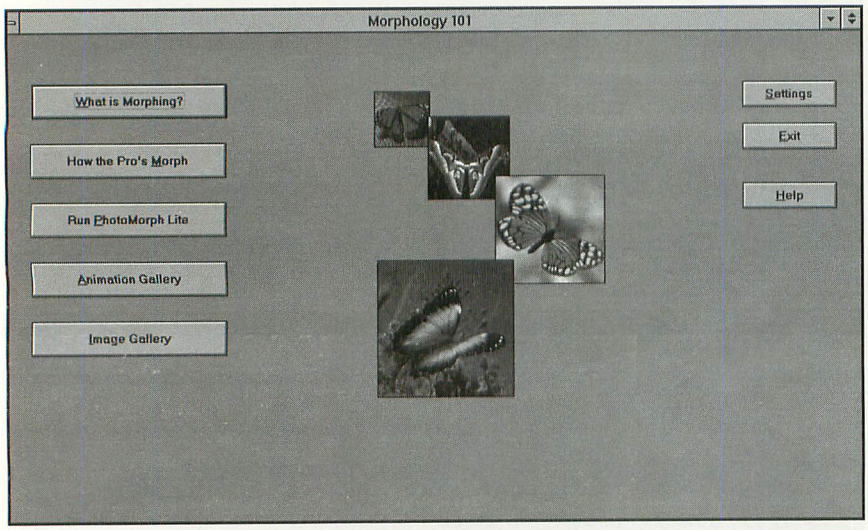
Similarly, clicking on an Image Gallery button invokes an image-selection screen that contains thumbnail representations and filenames for more than 300 photo images of animals, food, objects, people, plants, scenery, structures and other items suitable for morphing and which you can also copy and use royalty-free.



The "How to Morph" section provides a chalkboard that shows representations of Maxwell, Wilensky and Peay, Gryphon's resident morphing experts. Each expert does two segments through which invaluable knowledge, techniques and morphing tips are delivered via full-motion video. Morphing techniques are demonstrated during the video segments to illustrate what's being discussed in the narratives.

Matinee from Access Softek nicely rounds out the *Morphology* 101 package by giving the ability to turn your video clips into screen savers. You simply drag and drop your favorite morphs or other segments into the video sequencer and en-

The talking tiger sequence is a bonus narrative that's also accessible from the chalkboard and illustrates some of the truly amazing things you can do using the warping functions of the *Morph* software.



Morphology 101 uses action buttons to access different program segments from the main menu screen shown above. Though somewhat lackluster in appearance, compared to *Morph Movies*, the program still has lots of useful information, good examples of techniques and plenty of sample images and clips.

joy them during screen activity time-outs or by launching *Matinee* directly from its icon in the *Morphology* 101 program group.

All around, *Morphology* 101 represents a most-economical introduction to morphing and deserves a good recommendation as well.

Video Scan Converter with Genlock

If you're involved in multimedia production, you've probably had the need to route computer video to a VCR or projection TV receiver so that large audiences could view the display. The major problem with this has always been the incompatibility between computer-generated video and NTSC (television) video (the two mix like oil and water).

While converter cards have been around for several years to translate the VGA signal into NTSC, they were typically aimed at high-end users and usually had price tags that exceeded $1,000. Since they usually required a full-length 16-bit expansion slot, they were totally off-limits to laptop and notebook PC users.

Digital Vision has solved these problems in with its $800 TelevEyes/Pro computer-to-TV true scan converter. This neat unit connects externally and features genlock, the latter so that you can overlay and combine computer video with an NTSC video signal.

TelevEyes/Pro measures approximately 8¼"W x 1¾"H x 9"D and is powered by an included ac adapter. On its front panel are a pushbutton power switch, an accompanying LED power indicator and three light-touch pushbuttons for setting the operational parameters. The last step you through a configuration menu displayed on the TV receiver's screen to change parameter settings that give yes/no or up/down choices. These buttons control all of TelevEyes/Pro's features.

Pressing the Enter button freezes the video output. Pressing it again unfreezes it. Pressing either the Yes/Up or No/Down button displays the first menu selection to the composite or S-video monitor. You can reset the system to the default settings by simultaneously pressing the Yes/Up and Enter keys or by loading the default setup from the Access Setups menu selection.

Menu items are presented in the following order:

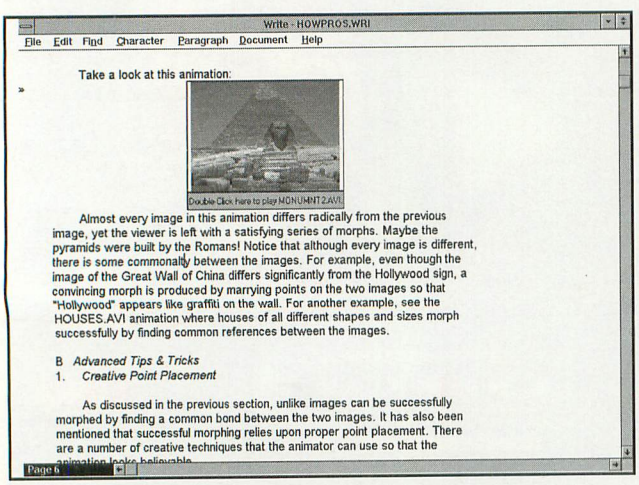
Flicker Filter?
Yes for flicker filter on, No for no filter
Overscan?
Yes for overscan output, No for underscan
Genlock/Overlay?
Yes for genlock on, No for genlock off
Advanced Controls?
Yes for advanced menu, No to exit menu
(Exit)

If you push Yes on the Advanced Controls item, the following choices are presented:

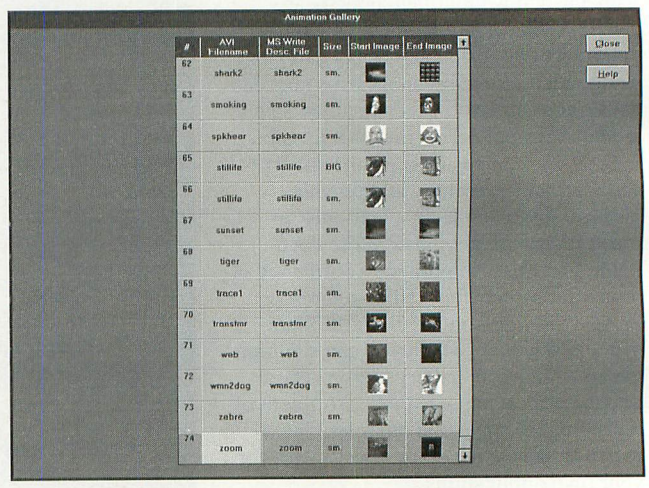
Access Setups? (Load and save previously-used menu selections and resets default setup.)

Change Genlock/Overlay Controls? (Selects overlay key color, video input source.)

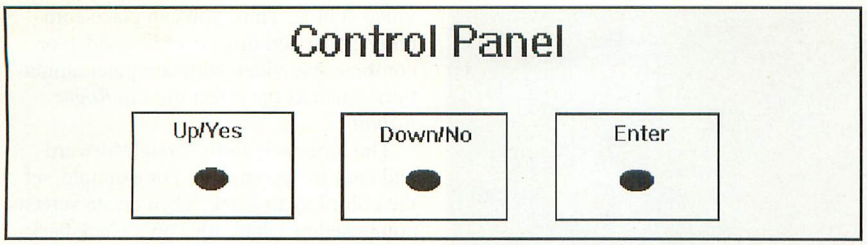
Change Flicker Filter Type? (Selects inter-



Windows OLE capabilities are used throughout the "How the Pro's Morph" document to provide animations that illustrate the techniques presented. Double clicking on any of the embedded bitmaps starts the animation in motion.



More than 70 morphed and warped animation sequences are provided on the *Morphology* 101 CD-ROM. Each has a corresponding document file in Write format that provides additional production information on the clip. Clicking on the desired filename in the Gallery invokes the player and loads the desired sequence.



Changing configuration preferences on TelevEyes/Pro is easy via the three control panel switches. Using an on-screen menu system, these switches are all that are required to step you through parameters and choices.

polation, averaging or replication filters.)

Change Brightness or Contrast? (Controls output video brightness or contrast and affects genlock key color selection.)

Change Positioning? (Controls output video centering or panning.)

(Exit)

Since TelevEyes/Pro is an external unit, you can use it with IBM/compatible and Macintosh computers, thanks to its unique video port/cable setup. The unit is supplied with a 29" video cable, at one end of which cable is a triple-row 15-pin D connector that plugs directly into a PC's video card, with a double-row 15-pin D connector (*a la* Macintosh) at the other end that connects to the corresponding jack on the rear of TelevEyes/Pro.

If you use TelevEyes/Pro with a Macintosh system, you simply reverse connection order, with the double-row connector attaching to the Mac and the triple-row end plugging into TelevEyes Pro. This is an ingenious and effective means of serving both platforms successfully.

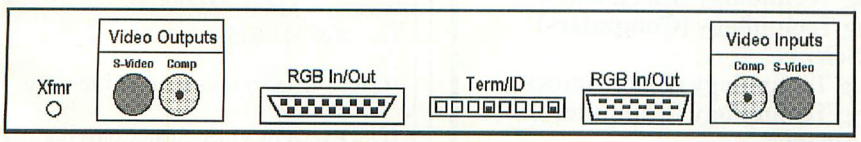
If you use TelevEyes/Pro with a Macintosh system, you simply reverse connection order, with the double-row connector attaching to the Mac and the triple-row end plugging into TelevEyes Pro. This is an ingenious and effective means of serving both platforms successfully.

In addition to the two RGB connectors described above, the rear panel of TelevEyes/Pro has a mini-phone jack for the ac power adapter, composite and S-Video jacks for video input and output and an eight-position DIP switch for selecting monitor termination. The DIP switches are usually moved from their default positions only when no computer monitor is in use (NTSC video output only), as when using TelevEyes/Pro with a laptop or notebook computer.

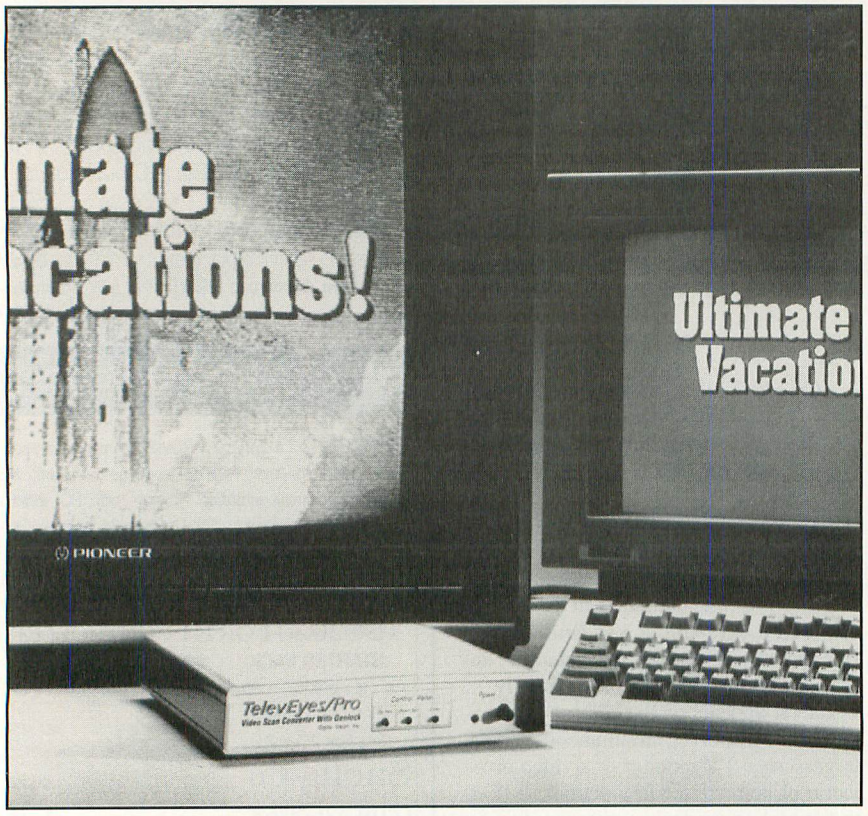
TelevEyes/Pro is unique in that it's truly a hardware-only video scan converter. No control software is needed by the host IBM or Mac computer to drive it because all programming is in firmware inside the unit. It's useful for just about any multimedia application since virtually whatever appears on the computer monitor can be displayed simultaneously on a large-screen TV monitor or a video projector or be recorded to videotape. I find that it makes an ideal companion item for recording my morphed/warped sequences to videotape for distribution to friends and distributing multimedia presentations in convenient, inexpensive VHS format.

If you need or desire to add computer titling or graphics to your live or taped video sources, TelevEyes/Pro is a terrific tool for such a task. By creating titles and/or graphics using your favorite *Windows* TrueType fonts and art/paint programs, you can add lots of zip and sparkle to otherwise ho-hum home videos when making dubbed copies. Even if your camcorder has a built-in title generator, it can't compete with the colors and artistic flexibility you can produce on your PC. This device provides an easy-to-use and affordable means to combine the two, by virtue of its built-in genlock feature.

Genlock simply means that the timing of two signals (computer video and secondary video source like a camcorder) are matched. Genlock makes it possible to



This illustration shows the I/O ports located at the rear of TelevEyes/Pro. By providing both Macintosh and PC 15-pin RGB ports and a unique cable with ends that mate to either of these connectors, the unit works with both PC platforms. Composite and S-Video signals are supported for input and output, but they can't be intermixed. The device also features genlock for overlaying and combining computer graphics with live or taped analog video signals.



Digital Vision's TelevEyes/Pro video scan converter with genlock makes it possible to overlay and combine computer-generated titles and graphics with live or taped analog video signals, as shown. The overlaid/combined output can then be displayed and/or recorded on standard NTSC TV receivers or VCRs.

perform a video overlay, where portions of both signals combine to form the output. Since you need to genlock to do an overlay, these two terms are often grouped together.

When Genlock/Overlay is on, TelevEyes/Pro replaces any computer-generated graphic (including titles) that falls within a certain color range (known as the color key) with live video from the secondary video source. Thus, you can place computer-generated titles over live video or combine live video with computer animations, such as the effect used in *Roger Rabbit*.

The process is fairly straightforward and easy to accomplish. For example, set the color key to black. Then create screens composed of white titles on a black background on your computer. When you genlock and overlay through TelevEyes/Pro, the black is replaced by the secondary video feed (from your camcorder or videotape) and white titles appear over the video. This combined output can then be recorded via the TelevEyes/Pro's video outputs to a VCR or be displayed on a TV screen.

The genlock/overlay feature works by first matching the timing of the computer video to the secondary video source (genlock). Then, as the video comes out, TelevEyes/Pro switches very quickly between digital computer-generated video and analog secondary NTSC video feed. The secondary video feed is never digitized. On any given video scan line, it passes through live video when the color-key condition is met (for example, the computer screen is black) and computer-generated video the rest of the time.

TelevEyes/Pro works remarkably well, is a cinch to set up and use and is a most-useful and affordable video tool for anyone who is serious about producing, displaying and recording digital computer video output on composite or S-Video analog NTSC devices. ■

Products Mentioned

Morph Movies CD-ROM, $45.95
Jasmine Multimedia Publishing
6746 Valjean Ave., #100
Van Nuys, CA 91406
Tel.: 818-780-3344

CIRCLE NO 135 ON FREE INFORMATION CARD

Morphology 101 CD-ROM, $39.95
Andover Advanced Technologies
239 Littleton Rd., Ste. 2A
Westford, MA 01886
Tel.: 508-392-0458

CIRCLE NO 136 ON FREE INFORMATION CARD

TelevEyes/Pro Video Scan Converter with Genlock, $799.95
Digital Vision, Inc.
270 Bridge St.
Dedham, MA 02026
Tel.: 617-329-5400

CIRCLE NO 137 ON FREE INFORMATION CARD

Microcomputer Q&A

By TJ Byers

In this column, I answer questions about all aspects of computer disciplines, both hardware and software, plus related electronic queries. You can reach me on America Online at TJBYERS, on CompuServe or Internet at TJBYERS@aol.com, or by mail in care of *MicroComputer Journal,* 76 North Broadway, Hicksville, NY 11801.

Pentium Flunks Math

Q. *I'm having a problem with my new Pentium PC—it can't do math. At first, I thought there was something wrong with the software, until I tried it for myself. I set up a long series of multiplication and division operations and let my Pentium PC do its thing. When it was done, the PC presented me with the wrong answer. I'm an accountant who does taxes for a number of large corporations, and I can't afford to be wrong. What can I do, short of buying a new system?* E. F., New York, NY

A. Like many other Pentium owners, you've discovered a bug in the Pentium's math coprocessor that eluded Intel until recently. In the company's defense, Intel released a press statement that states that the error rate is incredibly low—about one in 9-billion calculations—and that's the reason Intel engineers failed to find the flaw. Intel also disclosed that the problem is fixed and that bug-free Pentiums are now rolling off the assembly lines. While Intel has not announced a major recall program, the company is willing to replace your defective chip at your request. The Pentium hot-line number is 800-628-8686.

SX2 Versus DX2

Q. *I recently went "just-looking" shopping for a faster system, and ended up buying a 486DX2/50 on the advice of a salesperson. Two weeks later, I read a systems review in another publication that lists the performance for the 486SX2/50 and the 486DX2/50 as the same. If so, why would one buy a DX2? Would I have been better off plugging an OverDrive chip into my 486SX/25 system instead? I'm confused, and I feel like I've been duped.*—Ed Smith, Torrance, CA

A. The only difference between an SX2 processor and a DX2 is that the DX2 chip has a built-in math coprocessor, and the SX2 doesn't. When running programs like word processors and databases or when playing games, the math coprocessor doesn't make a hoot of difference. However, if you do a lot of spreadsheet work or use drawing programs, the math coprocessor provides a big speed improvement. Yes, you could have gained the same speed advantage and the math coprocessor by installing an OverDrive chip in your old system. But I'm sure your new system has greater expansion potential. For example, it's likely your 486DX2/50 has a local-bus slot and the motherboard accepts a Pentium OverDrive chip (when it becomes available), whereas your 486SX/25 won't.

As for being taken in by a slick-talking salesper-

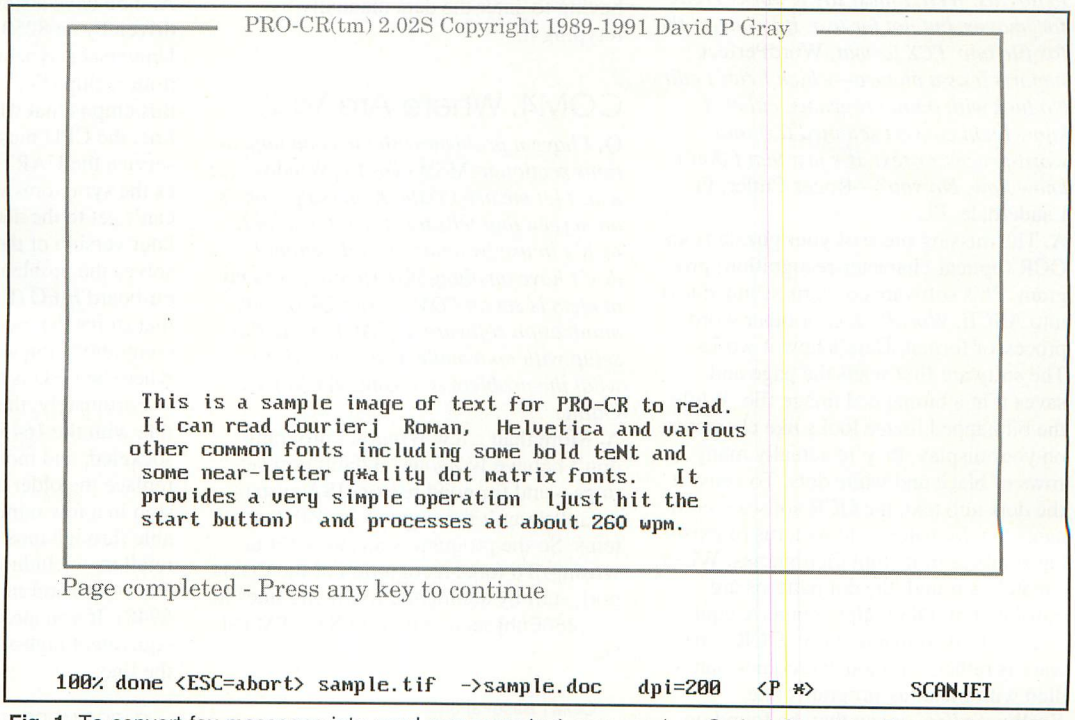


Fig. 1. To convert fax messages into word-processor text, you need an Optical Character Recognition (OCR) program. Shareware OCR program *Pro-CR* can convert scanned text into ASCII format. Like all OCR software, *Pro-CR* isn't perfect. Expect to manually fix up to 10% of the scanned characters.

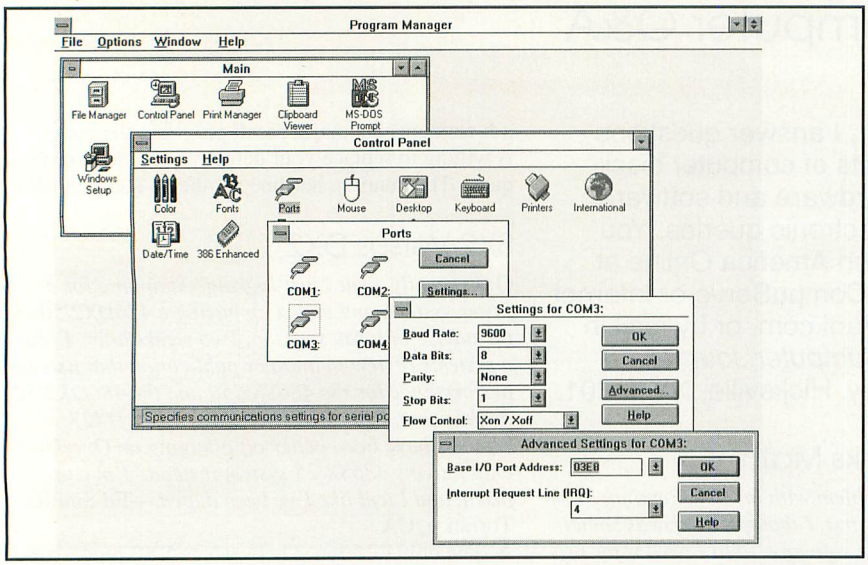


Fig. 2. The Advanced Setting from the Control Panel's Port option lets you define the port's I/O address and interrupt. To set COM port speed, select Baud Rate and use the scroll bar to highlight the desired setting. If you need a setting that isn't listed, type the value in the text box, using the keyboard.

son, it's always "buyer beware"—or, at least, street smart. Check out the article "Computer Jargon Defined—Buying Smart" in this issue for more on the computer buying game.

Using Fax For a Scanner

Q. *I heard that you can use a fax machine as a scanner by faxing a document to yourself and saving it as a file. So I tried to do this. Well, I must say it works great for images, but not for text. If I convert the fax file into .PCX format,* WordPerfect *imports it as a picture—which I can't edit. No luck with paint programs, either. I know I can convert scanned text into word-processor text, it's just that I don't know how. Do you?*—Roger Cutler, Ft. Lauderdale, FL

A. The missing piece of your puzzle is an OCR (optical-character-recognition) program. This software converts scanned text into ASCII, *WordPerfect* or other word-processor format. Here's how it works. The software first scans the page and saves it in a bitmapped image file. While the bitmapped image looks like characters on your display, they're actually many rows of black and white dots. To convert the dots into text, the OCR software compares the dot patterns to patterns of existing symbols in its font dictionaries. When a match is found, the dot patterns are translated into their alphanumeric equivalents and saved in a text file. OCR software is rather common and comes bundled with most fax programs like *FaxWorks Pro*, or can they be found on many BBSes and on-line services (Fig. 1).

The problem is that the conversion process isn't perfect. Often, fax characters have broken or missing sections that are caused by dirt, smudges or just lousy hard copy. Then there are the hundreds of font types that the OCR software must deal with. Proportionally-spaced text is particularly difficult to identify. A good OCR program will have a "hit" rate of 90% or better, which means you'll have to go into the document and fix about 10% of the text. But this is a whole lot easier than having to enter the data manually by retyping it.

COM4, Where Are You?

Q. *I have a problem with the communications section in* MSWorks for Windows: *It won't let me use COM4. A message comes on-screen that tells me it's not available or it's in use by another application. I don't have anything else running and my modem is set on COM4. I run* QLII *communication software and AOL using this setup with no trouble. Can you tell me what the problem is?*—Jim, via America Online

A. More than a few *Windows* programs don't believe *Windows*' default port settings—and for good reason. ISA system defaults aren't the same as for EISA systems. So the program wants to see it in writing. To force recognition of the COM4 port, start by adding the following lines in the [386Enh] section of your SYSTEM.INI file:

```
COM1 Base=3F8h
COM2 Base=2F8h
COM 1 Irq=4
COM 2 Irq=3
```

The COM port Base I/O Port Address and IRQ can also be set from *Windows* using the Port option from the Control Panel (Fig. 2). On an ISA system, COM1/COM3 and COM2/COM4 share the same interrupts (IRQ4 and IRQ3, respectively), but each port has its own I/O address. Unfortunately, *Windows* doesn't know this. You have to tell it so by manually adding the following lines to SYSTEM.INI:

```
COMIrqSharing=true
COMxFIFO=0
```

This should take care of your problem. If it doesn't, try trading the COM1 and COM2 values: that is, COM1 = 2F8h and IRQ3 and COM2 becomes 3F8h and IRQ4. Don't forget to give *MSWorks* this information. If the swap works, you'll need to go back to *QLII* and your AOL software and make the appropriate changes there as well.

Modem Errors at 14.4k

Q. *I recently purchased a 14.4 fax/modem at a computer show, but I'm having problems using it. At 2,400 bps, the modem works fine. At 9,600 and 14,400 bps, though, I sometimes get line noise and a scrambled, unreadable screen. When I try logging onto the same BBSes using a friend's 14.4 modem on her Mac at 14,400 bps, everything works fine. Is something wrong with my modem?*—Barbara Kuta, via Internet

A. You have a slow serial port, probably driven by an 8250 or 16450 UART, or Universal Asynchronous Receiver/Transmitter, chip (Fig. 3). The problem with this chip is that when a message is on the line, the CPU must drop what it's doing to service the UART, which sometimes causes the symptoms you describe if the CPU can't get to the data quickly enough. A later version of the chip, the 16550A, solves the problem by including a 16-bit on-board FIFO (first-in, first-out) buffer that stores the incoming data. This permits communication to keep flowing even when the CPU is busy with other chores.

Fortunately, the 16550A is pin-compatible with the 16450. So if your UART is socketed, and most 16450s are, you can replace the older chip with the newest version in a few minutes. The chip is available through most electronic component retailers, including DigiKey (tel.: 800-344-4539) and Jameco (tel.: 800-237-6948). If you already have a 16550A or equivalent high-speed UART, try adding the line:

```
C:\DOS\MODE  COMx:19
```

to your AUTOEXEC.BAT file to set the

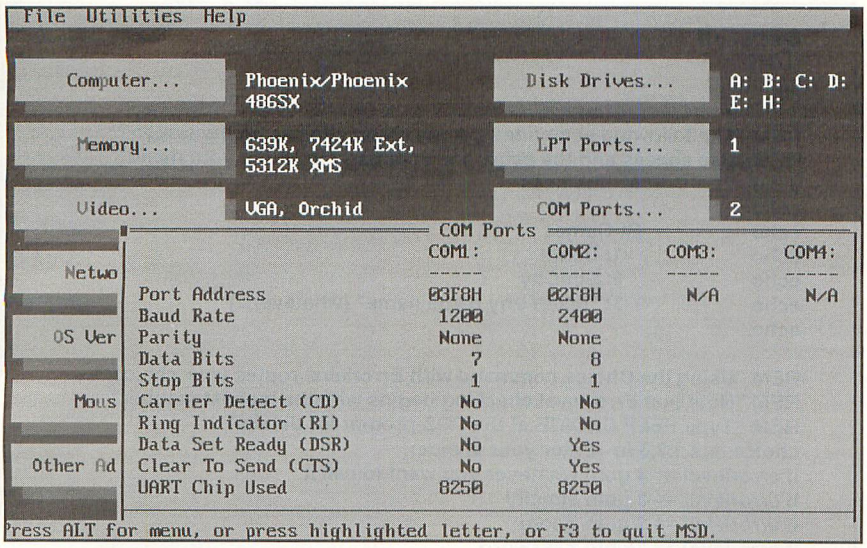


Fig. 3. To find out what type of UART chip is installed in your computer, use the MSD Microsoft diagnostic utility. You'll find the chip type listed under Ports.

port's speed at 19,200 baud. Note that the *x* in COM*x* specifies the number of the serial port connected to the modem. Valid numbers for *x* are 1 through 4. *Windows* users can increase the speed of the port by selecting Ports from the Control Panel and changing the baud rate to 19,200 (Fig. 2).

If your UART isn't socketed, get a copy of BNU, a common FOSSIL (Fido-Opus-SEADog Serial Interface Layer) driver, which can be found on many BBSes, and load it like this:

```
BNU /R2048
```

This adds a 2K buffer to the serial port that emulates the 16550A's buffer and reduces the quantity of errors to an acceptable number. Many popular programs that deal with telecommunications use it, including *QuickBBS* and *BinkleyTerm*. BNU works with notebook PCs, too.

PCMCIA Modem Madness

Q. *I have a DX4-74 notebook with a 14.4 bps PCMCIA modem that behaves erratically. After much fiddling, I managed to get it to work with my CompuServe software, but not the America Online software. Sometimes, the modem will log onto AOL. But, more often than not, the modem doesn't respond to handshaking. And, yes, I've checked all the usual connectivity stuff, like changing COM ports and reassigning IRQs. Any thoughts?*—Kurt Reynolds, via CompuServe

A. Yes, PCMCIA products are still in their infancy and have a lot of growing up to do before they get "teeth." You didn't say which brand modem you have, which is very important because not all modems are alike. I suggest you call the modem maker's tech-support people and see what they know about the AOL software problem. It's possible they have a fix or workaround.

You might also want to give the new AOL software—which you should have received in the mail by now if you're a subscriber—a whirl and see if it fares better. The PCMCIA software drivers have a lot to do with PCMCIA compatibility, and changing your drivers may solve the problem. I find the CardTalk drivers from DataBook (tel.: 607-277-4817) to be the most-stable. If nothing works, return the card to your dealer and exchange it for a different brand, one that works with your communications software.

Password Protection

Q. *I use my home computer to help run a small business. However, my kids also use the computer for games. I'm very concerned about the kids getting into the business files and accidentally trashing them. If I keep all my business related-files under one directory, is it possible to have two boot configurations: one that does not allow* any *access to the business subdirectory and a second password-protected configuration that permits access?*
—Ross M., via America Online

A. Before Microsoft decided to yank MS-DOS Shell from DOS (essentially killing it), it could do what you ask. However, it was rather easy to defeat the password, and the Shell's GUI (Graphics User Interface) left a lot to be desired. Fortunately, it's not difficult to write a batch file routine that does a decent job of serving up intuitive menus while providing adequate password protection.

Figure 4 lists one way this can be done. The first few lines reset the screen and set up the menu. Use the space bar and ECHO command to position the menu options on the screen. The Choose command uses Errorlevel and the GOTO command to direct your keyboard response to the selected menu option listing.

The Business option provides three levels of file protection. First, you're asked for a password; the Prompt $e[8m command blanks the screen so that the kids can't look over your shoulder and sneak a peek at the password while you type. In my example, the password (TJBYERS) is contained in the second line of the P.BAT file. Of course, you can change the password to anything you wish by substituting my password with any string of ASCII characters or symbols—except for a space—that can consist of up to 225 characters.

The password entry must begin with the letter P, followed by a space, then the password itself. If you enter the incorrect password, the machine locks up, courtesy of the CTTY command, from which the only recovery is a system re-boot.

The third line of defense is the ATTRIB command, which sets the files to read-only and then hides them from view. Even if your kids are able to crash the password and log onto your business directory, all they'll find is a directory of invisible files they can't change. Only the correct password (or a hacker who knows about attributes) can open them.

Let's not forget about the wee ones: Making it easier for the kids to start their games gives them less opportunity to accidentally mess up your files. When you choose a Games option, the menu automatically opens up the game and starts it running. When they're finished playing, the CALL command returns them to the main menu, where they can select another game or turn off the computer. Additional games can be added to the menu by continuing the 1-2-3 sequence and inserting the appropriate Errorlevel and GOTO lines, as outlined by the "(whatever...)" option.

Password Problems

Q. *I inherited a very nice 486SX computer that I'm champing at the bit to use. The problem is the system is password-protected and no one knows what the password is. I have tried to boot with a system disk, but it never reads the boot disk before the password prompt rears its ugly head. To make matters worse, it's a no-name clone with no manual. The only clue I have is a message at boot-up that states that it has an AMI BIOS dated 1991. Any Suggestions?*—Henry A., via America Online

A. Fortunately, it's very easy to change the password on computers with an AMI BIOS. Simply turn on the machine and press the Del key while the system is checking the memory, then choose the Change Password option from the menu. Some systems, notably the PS/2, don't let you change passwords if you forget the old one. In cases like this, you can erase the password by turning off the power and disconnecting the CMOS battery for about 30 minutes. The drawback is that you'll have to reconfigure the CMOS setup after reconnecting the battery because its contents, too, will be erased.

Windows' Swap File Revisited

Q. *My hard disk is compressed with DoubleSpace. Last week, I decided to optimize the drive by running Defrag. I first went into* Windows *and set my swap file to none. I then quit* Windows *and ran Defrag from the DOS prompt. Next I attempted to reinstall my swap file, but with no luck. Instead, a message popped up stating that the permanent swap file was corrupted and that I needed to delete it. Confused, I decided to create a temporary swap file instead. However, it's not as fast as my permanent swap file. What do I have to do to get my permanent swap file back?*—Jan Wilder, Brooklyn, NY

A. I hope you're not trying to create the swap file on your compressed drive. If you are, be advised that it won't work. The swap file must be installed on an *uncompressed* drive. If you're trying to install the swap file on an uncompressed drive that you just defragged, then, yes, the old file is likely scrambled because of the defragger. To fix the problem, quit *Windows*, go to the root of the drive and locate the 386SPART.PAR file, which is the permanent swap file. Since this is a hidden file, you'll need to type:

```
DIR /AH
```

to see it. Next, unhide the file using:

```
ATTRIB -H 386SPART.PAR
```

and erase it with:

```
DEL 386SPART.PAR
```

Now you can start *Windows* and create your permanent swap file.

Battery Soldered To Motherboard

Q. *My 386SX/33 clone's CMOS battery (a little barrel-shaped affair made by Varta) is beginning to fade. I know, because I have to enter the date and time manually*

```
@echo off
:start
cls

REM "The following echo lines put the menu choices on the screen"
REM "Use spaces and the echo. line command to layout your menu"
echo            A: Business
echo.
echo            B: Games
echo              1: Doom
echo              2: SimCity
echo              3: "insert any game name" (whatever...)
echo.

REM "Using the Choice command with Errorlevel routes your choice"
REM "Note that Errorlevel checking begins with the highest number"
REM "Type HELP CHOICE at the DOS prompt for details"
choice /c:a,1,2,3 /n  Enter your choice:
if errorlevel == 4 goto whatever you want to call it
if errorlevel == 3 goto simcity
if errorlevel == 2 goto doom
if errorlevel == 1 goto password
goto start

REM "And here are the choices..."

:password
echo Enter your password, now
prompt $e[8m
goto end

:doom
call c:\games\doom\doom.bat
goto start

:simcity
call c:\games\sim\simcity.bat
goto start

:whatever you want to call it
call path:\filename
goto start

:end
```

PASSWORD.BAT

```
@echo off

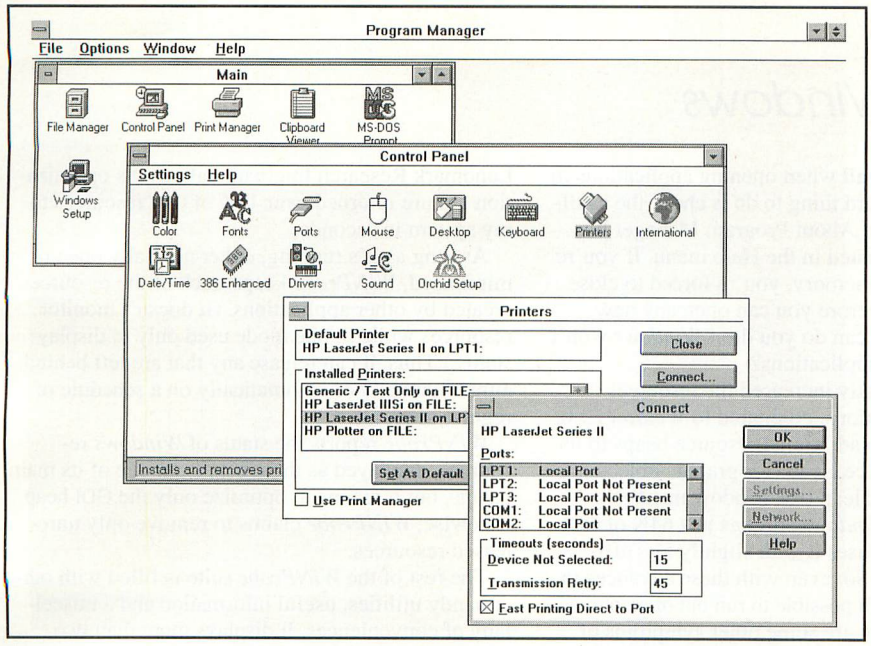
:start
if "%1" == "TJBYERS"  goto okay
ctty lpt3
goto end

:okay
cd e:\business
attrib -h -r /s
prompt $e[m$p$g

call win
attrib +h +r /s
:end
```

P.BAT

Fig. 4. The are several ways to protect your files with password protection. These two batch files show one way it can be done using the Attribute command. To work, properly, both files must be in the same directory, with the line *d:\path*\PASSWORD .BAT added to the AUTOEXEC.BAT file. The second line of P.BAT contains the password, which can be any string of ASCII characters (except spaces) up to 225 characters long.



User Tip: Despite its intent, *Windows*' Print Manager often slows down *Windows* applications, rather than speeds them up. Many programs, like *Word for Windows*, have a built-in print spooler, which means your print files are queued twice: once by the application and again by Print Manager. Disabling Print Manager makes the pages come out of your printer faster. Whether or not you use Print Manager, you can get an extra spurt of printer speed (if you're not on a network) by checking the Fast Printing Direct To Port box found under the Control Panel/Printers/Connect option, as shown here.—*Connie Phillips, San Clemente, CA*

every morning when I start. However, I discovered to my dismay that the battery is soldered to the motherboard. I don't relish having to take the machine to a repair shop and paying big bucks to have a new battery soldered into place. Is there any way to replace the battery without having to go to all this trouble and expense?—John Martin, New York

A. Whatever you do, don't try to unsolder it! You could kill your motherboard. Instead, use small cutters to clip the battery leads (two flat tabs) as close as possible to the body of the old battery so that you have two free leads projecting up from the motherboard. If necessary, use a hobby knife to trim away the plastic cover to gain access to the leads. Now, observing polarity, lower the new battery into place between these leads and solder the new battery's tabs to the old tabs.

If you don't have a soldering iron, don't panic. Use solder tape—a very thin strip of solder that melts with the heat from a match. Radio Shack sells a package of 100 strips (Cat. No. 64-010) for just $1.49.

If you can't get to the battery, you may be lucky enough to have a motherboard that has an external battery connector, too. It's about 3/8" long with four metal pins sticking up. Check your owner's manual for exact location. Most likely it's next to the battery itself. If you have a connector, all you have to do is buy an external CMOS battery holder that holds four AA cells and has a black-and-red twisted-pair pigtail lead coming from the case, find a place to mount it inside your system unit and plug its connector onto the motherboard.

Does POWER.EXE Save Power?

Q. *What use is the DOS Power command? Does it save wear on the CPU, electric power or what? Does pressing the* Pause *key do anything to save power, save wear on CPU or just nothing?*—Martha, via Internet

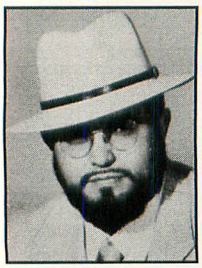
A. The Power command reduces power consumption during the times the PC is idle. It conforms to the Advanced Power Management (APM) specification—a standard created by Microsoft, Intel and Phoenix in the early 1990s. Essentially, APM is a set of rules that let an application running *Windows* 3.1 communicate with the power-management portion of the system's BIOS. During operation, the application or *Windows* senses an idle condition where parts of the system are doing nothing. This information is passed on to the BIOS, which shuts off power to that device until it's needed again, thus saving power.

Generally, the APM applies to notebook PCs and finds only limited use in "green" (power-saving) desktops. This is probably why you're confused about the Pause key. In many notebooks, there's a special button labeled pause that, when pressed, puts the PC into sleep mode. On the other hand, the Pause key on the keyboard does absolutely nothing and has never been used by any program known to me. However, its alter ego, Ctrl-Break, is often used to terminate a program.

Needs Trident Upgrade

Q. *I have a two-year-old Trident video card for which I'd like to get the latest drivers. However, I can't find Trident's telephone number. Is there any other source for update drivers?*—Jerry Rice, Menlo Park, CA

A. Trident is still in business, and you can download drivers from its BBS (tel.: 415-691-1016). For readers in search of drivers whose vendors are out of business, you might find what you need on CompuServe. For instance, if it's a Microsoft product like *Windows* for which you need a driver, type GO MICROSOFT at any ! CompuServe prompt. ■



By Yacco

GUI Guts

Tuning *Windows*

If you run into a wall when opening applications in *Windows*, the standard thing to do is check the available resources in the About Program Manager box. You'll find About listed in the Help menu. If you're out of resources or memory, you're forced to close some applications before you can open any new ones. But what else can do you do if *Windows* won't let you open more applications?

Windows 3.1 greatly increased the resources available to applications, compared to *Windows* 3.0. In fact, it added two additional resource heaps to its original GDI Resource Heap (for graphic objects) and User Resource Heap (for window management). However, *Windows* still has just 64K of GDI Resource, and now uses it with slightly less efficiency than before. So, even with these advances in *Windows* 3.1, it's still possible to run out of resources.

Incidentally, there are some other symptoms of low resources besides an inability to open additional *Windows* applications. If you're having trouble running internal and external DOS commands, such as TYPE and MORE, or you're unable to switch back from the DOS shell to *Windows*, other than by exiting DOS, you may be running out of certain resources *Windows* needs. I found that adding file handles and buffers had no effect on this problem, but closing *Windows* application did—even when I dramatically cut file handles to 10 and buffers to one.

Occasionally, there are things you can do to open more applications, even when you're out of resources. With *Windows* 3.0, reducing the number of icons and other objects on the desktop helped. Other solutions included closing groups in the Program Manager, unloading fonts that weren't needed and eliminating wallpaper.

Methods like theses are still effective in *Windows* 3.1. Microsoft recommends the following strategies:

- Minimize seldom-used groups.
- Eliminate wallpaper entirely, or tile small bitmaps.
- Close Program Manager groups that have many icons whenever possible.
- Don't load fonts that aren't used.
- Keep an application open, rather than frequently closing and reopening it.
- Avoid using screen savers that tax resources.

The last couple of recommendations address peculiar phenomena that can slowly consume the space in a heap. It seems that unnecessary resources can accumulate in a heap if an application crashes or when a poorly-written *Windows* application exits normally without freeing them. Thus, some resources may be reallocated each time you open an application, even thought they're not released when you close it. *Windows* relies on applications to manage their own resources and can't do anything if the heap becomes cluttered with garbage like this.

WINProbe 3.0

While *Windows* can't do anything about these orts and dregs, the *WINProbe* diagnostic suite from Landmark Research International can. Its optimization feature returned over 13K of GDI resources to my system in seconds.

As long as it's running, either normally open or minimized, *WINProbe* keeps track of the resources created by other applications. (It doesn't monitor resources while in one mode used only to display status.) Thus, it can release any that are left behind, either manually or automatically on a schedule of regular intervals.

WINProbe reports the status of *Windows* resources, displayed as three heaps, on one of its main panels, but it claims to optimize only the GDI heap. Likewise, *WINProbe* claims to remove only unreleased resources.

The rest of the *WINProbe* suite is filled with other handy utilities, useful information and a miscellany of conveniences. It displays more than two-dozen pieces of system information on it's main panels. At a glance, you can see your basic system hardware, *Windows* configuration and the number of current tasks, files and modules. The system workload and cache hit-rate, along with free RAM and percentage of available system resources, are all displayed dynamically.

One of the diagnostics I ran shows a distribution of storage resources. The histogram quickly disclosed that a directory full of introductory material I never reference was occupying 66M of hard-disk space. I might never have noticed the directory was occupying such a significant percentage of the Thinkpad's generous 340M were it not for this report.

WINProbe's other features include the ability to test and/or report on just about every hardware or *Windows* resource on your system, from math co-processor to VxD drivers. One report, called the Installation Wizard, helps find the ROM address space, hardware interrupts, I/O port addresses and DMA channels needed to install adapters. The program's utilities find file duplicates, compare .INI files, back up system files and compare current system files to the backups. Besides resource heaps, *WINProbe* also tunes up SMARTDRIVE, Program Manager, *Windows* memory management, video and .INI files to make them more efficient.

Additional tune-up suggestions reside in the quite comprehensive "*Windows* Tune-Up" report. Many advise you how to get rid of resource hogs, but there are also a couple of very cool tips. For example, after making changes to your WIN.INI file, *WINProbe* suggests simply double-clicking on the keyboard in the *Windows* Control Panel to make them take effect immediately, without requiring you to quit and restart *Windows*.

You'll like *WINProbe*'s interface once you get used to it. It's huge toolbar is clever and accessible. More-important status items are presented both digitally and with analogs. The program's only genuinely annoying weakness is that keyboard support has generally been ignored. There are a host of buttons

that don't work with the indicated Alt-key combination and can't be accessed by Tab keys. You've got to use the mouse. Grrrrr! (Landmark says that keyboard access for these buttons is being addressed.) I found just one shortcut key, by accident, and none are documented on the menus.

WINProbe has a few minor inconsistencies. Not all the report windows have horizontal scroll bars, and not all of those that do have them work properly—at least not all the time. I found one bar-less window that I could move with the cursor keys regardless, but others had to be maximized to be seen. (Landmark claims these scroll bars are being addressed.) Also: some *WINProbe* windows close with either the Esc key or Alt-F4, but others close only with Alt-F4.

There's also one very unconventional thing *WINProbe* does to confuse you. When you initialize a new report, its window covers the left display panel and obscures the status report. There's no obvious control to get the status panel back. However, if you look to the far right, you'll find a strange button—marked with a red cross in a circle—directly under the maximize arrow. Pushing this Data Window button causes the report to become a separate application window and, once again, exposes the status display panel. If the report lacks a scroll bar, you can expand it and see its right side.

The developers undoubtedly gave a great deal of consideration to the appearance of the display panel when they designed this little trick and its Crusader Rabbit button. I'm sure that the esthetics of these reports are sublimely pleasing as a result. However, it's so nonstandard and unlike anything you're likely to have seen before that you'll probably find it confusing at first. Furthermore, if a report window isn't opened properly, the lack of an exit confirmation dialog allows *WINProbe* to close unexpectedly if you try to shut the report with Alt-F4.

WINProbe's ability to automatically compare and edit .INI and system files works beautifully for the few files it will access. All lines not found in the first file are followed by all the ones not found in the second file. However, the program doesn't let you compare any .INI files that don't have the .INI extension, and it compares only the current system files to the ones it automatically saves. It would be vastly more useful if it let the user select the files to compare without restriction.

Many of the applications I install, and there's more than a few, save the old .INI files with a mnemonic extension. The *Norton Utilities*, for instance, saves copies with an .NU8 extension. Many other programs use a numbering scheme such as .I01, .I02, etc. Unfortunately, none of these files can be compared, unless you rename them. Comparing system files is yet more complicated. You must first use them to replace the .SAV files that *WINProbe* stores in it's directory.

It's my practice to keep copies of the majority of my old CONFIG.SYS, AUTOEXEC.BAT, WIN.INI and SYSTEM.INI files, and I recommend it to everyone who is planning a new product installation. My own extension scheme is a simple .001, .002, etc. I use it for only these files. So, I don't need the initial "I," "S," or "B." *WINProbe*'s automatic comparison comes within 24 bits of being a lifesaver. However, all the renaming is simply too inconvenient. So, I continue to manually compare these files in Notepad.

I found a few minor problems with the product, too. For one, the documentation adds almost nothing to it. It was yanked straight out of the help file, and it's printed with a very small font. I'd guess it's presently only 6 points, at best. (Landmark is reportedly preparing to ship a new manual with larger type.) It's difficult to find things in the manual as well. Fortunately, Landmark's technical support is on its toes, or you might never discover what all the gauges on the main display panel mean.

There's at least one inaccurate report in *WINProbe*. The PCMCIA report insists that both the PCMCIA sockets in my Thinkpad are empty. Nevertheless, the XJack modem in slot 1 is working perfectly, and *WINProbe* itself finds XJack's UART chip with its communications port diagnosis.

SHARE violations plagued *WINProbe* on the ThinkPad, which runs PC-DOS. For example, I have yet to get a complete tune-up report on Program Manager. The tune-up is supposed to be deleting icons only for applications that have already been removed from the system. So, there doesn't seem to be any reason for a conflict with SHARE.

One, and possibly two, things are missing from *WINProbe*. First, I'm not sure that the product's memory map is currently very useful, but I do know it's incomplete. It doesn't report what's in lower memory, and it didn't change as I expected it to when I pulled out the XJack. What's needed most is a report that discloses the amount of memory available to DOS sessions. It's not very useful to merely say that a machine has 640K of low memory. Which doesn't?

Second, according to *WINProbe* all of my resources are far from exhausted. Yet, I'm unable to open additional applications. I suspect this is related to main memory and might be resolved by a memory report. If it's not, then *WINProbe* needs to disclose something else. Don't ask me what; that's what I'm depending on Landmark to know.

Finally, *WINProbe* doesn't seem very good at handling exceptions. It's somewhat crash-prone. However, since *WINProbe* is essentially passive, and since it has the grace to not bring down *Windows* when it crashes, I found this and all of the other problems merely annoying, rather than intolerable. Furthermore, many of my complaints are already being addressed. But, even if they weren't, *WINProbe*'s benefits far outweigh its drawbacks. I have every intention of keeping *WINProbe* in my Program Manager even though this resource is 91% exhausted, and I can't get *WINProbe* to tune it. I'd probably keep it for the *Windows*-resource optimization alone.

Not all the resources needed by *Windows* are disclosed in the About box or by *WINProbe*. It's not unusual to find you that can't open more applications even when *Windows* seems to have plenty of available resources. This is undoubtedly because the operating system and environment have such a complex relationship. DOS resources, for example, can affect both *Windows* and applications running in DOS sessions.

A resource you may be able to free in the interest of improved *Windows* performance is low memory. For example, take a look at the file handles and buffers you're reserving in your CONFIG.SYS file. You're probably providing 40 or more handles and a score or more buffers as well. *Windows* itself needs a few handles and buffers. However, your *Windows* applications obtain these resources directly from *Windows* itself and from SMARTDRV.EXE, not from DOS.

Allocating too many of these resources can cut memory needed not only by DOS applications, but by *Windows* as well. The parts of *Windows* that talk to DOS sit in low memory. *Windows* also has some internal buffers that are used for transferring data when the processor switches between its real and protected modes. These buffers must also be in memory below the 1M boundary. Without them, *Windows* couldn't create its virtual machines. As important as these binary creatures are to the well-being of *Windows*, though, their habitat is steadily being encroached by the advance of civilization. The latest threat is the PCMCIA driver suite. On the Thinkpad, it's difficult for me to free up more than 450K—430K free is a more-typical figure.

If you do most of your work with native *Windows* applications, try reducing your file handles to 10 and your buffers to 5. Also add a 0 to the end of your Buffer statement to eliminate secondary buffers.

The statement should read: BUFFERS=5,0. If you must squeeze the very last bit of memory from DOS, you can actually reduce the number of buffers to as few as 1, but at the cost of far slower file opens and saves. Note also that some DOS applications may require more than 10 file handles, either while running in a *Windows* DOS session, or under DOS itself. If one does, you can add what it requires. However, the more you move to *Windows* applications, the less this will be a concern.

Virtual Memory

If my suggestions for file handles and buffers appear counter-intuitive, my suggestions for virtual memory seem to fly in the very face of Microsoft's own recommendations. However, I suspect that Microsoft's recommendations were formulated, in part, to address criticism for slow *Windows* performance on 386SX processors. The following strategy is likely to serve you better if you have a newer processor and/or if your principal concern is storage, rather than speed.

The amount of storage *Windows* recommends for your virtual memory is about half of available space. If you accept this recommendation for a large, empty hard disk, you're certain to allocate more resources to virtual memory than needed. But even if you just follow Microsoft's published guidelines and allocate an amount equal to RAM, you may be wasting space. I find that the Thinkpad's 12M of memory requires no more than 8M (8,000K) for virtual memory to provide excellent performance. You can probably get by with less. I've reduced it to as little as 2,000K (2M) with acceptable results.

You can experiment with virtual-memory values to suit your own processor, applications and personal preferences. Make your changes via the Enhanced 386 utility located in the *Windows* Control Panel. Note that the most-efficient way to allocate virtual memory for *Windows*' enhanced mode is to create a permanent file. This avoids fragmentation that can lead to thrashing when you switch applications.

Next, load your applications and check the About box (or *WINProbe* panel) to note the available virtual memory. You should avoid reducing it to a level that produces noticeable disk thrashing or excessive delay when you switch applications. You'll want to consider how long it takes to open and save applications, too. But a slight performance hit may well be a tradeoff you're willing to accept if you have a pressing need for more storage.

Don't be afraid to play with virtual-memory settings. Begin with gross changes, but make final changes gradually. If a change improves performance, repeat the same type of change, until you stop getting improvements. If a change negatively impacts *Windows* performance, or prevents you from opening enough applications, it's easy to put things back to where they were.

iniExpert

While I have some reservations about the way *WINProbe* handles .INI-file comparisons, I have none about what another Landmark products does with them. Landmark's *iniExpert* can take you into all the standard *Windows* .INI files and tell you, line by line, just what each statement does. This is handy if you're curious about a setting. However, it also makes a great diagnostic tool for sniffing out the non-standard lines that poorly-mannered *Windows* applications stick into *Windows* .INI files.

The preferred way to provide application references is for the application to create an independent .INI file or to add lines to the *Windows* reference files that use resources located in the application's own directory. The latter method requires a path that immediately lets you know the line's been added to the .INI file and by which application.

Unfortunately, many applications rudely add lines and stick their modules into the *Windows* directory as if it were a bottomless pit. If you do a lot of *Windows* configurations or application installations *iniExpert* will make a suitable addition to your tool kit.

Internet Software, Part I

Windows software is making the Internet easier for everyone to use. It's also making the net accessible to the class of command-line-adverse users for the first time. As I stated in the last installment of GUI Guts, I'll begin examining the software you need to explore the Internet via *Windows* with this issue.

The first two applications I'll cover are the first two that most users will use. E-mail is the most basic application. With all the mail gateways available from on-line services, e-mail is one that's growing more rapidly than the Internet itself. Another essential piece of software for the Internet is the news reader for accessing the world-wide bulletin boards known as the Usenet news groups. Both applications let you connect to other users and give you a perfect means for learning more about the net.

Even if you don't know a single person with a mailbox before you get on the Internet, e-mail comes into play in support of many other network activities. For example, I use e-mail to communicate privately with people I meet through Usenet news groups.

Of course, users aren't the only ones you'll send mail to on the net. I recently used Internet e-mail to subscribe to the *Olympia Review*. I simply sent Michael McNeilley, the small literary magazine's publisher, my order and credit-card information.

MicroComputer Journal and most other computer-oriented publications have had e-mail addresses for years. Now, it's spreading to the general media and beyond. Many magazines including *Time*, *Omni* and *Wired* are now available on-line. Time regularly publishes letters to the editor that it receives on-line, and the NBC television newsmagazine, "Dateline," encourages its readers to respond with comments via it's Internet address.

The Infobahn is loaded with E-Zines, electronic magazines that are distributed through e-mail. CompuServe, too, has a number of news sources on-line, including a very hot CNN Forum. In the near future, you can expect all news-gathering organizations to either have an e-mail address or be out of the loop. Certainly, they'll have less currency than the competition if they don't have e-mail's immediacy.

Organizations that use e-mail aren't limited to the media, either. The White House now has an e-mail address to which you can send mail to the President and Vice President. You can use e-mail to communicate with the stores you find on the World Wide Web. Sooner or later, it's bound to become as universal as our most popular forms of electronic communication: sooner—as common as the fax, later—as widespread as the telephone.

• ***Eudora* 1.4 and 2.0.** Qualcomm's popular *Eudora* Internet mail package—for *Windows*, Mac or *X-Windows*—supports the Simple Mail Transfer Protocol (SMTP) and Post Office Protocol Version 3 (POP3). Many users prefer it for their e-mail, despite having a suite like *Chameleon*, which has its own mail module, for most of their other network needs. *Eudora* is available in both shareware and commercial versions. The two are almost equally feature-rich.

Eudora has a lot to offer, including: queued or instant sending; a mailbox system and easy management tools with which to organize messages; a powerful search utility to find any text or message; several directory-sort criteria; a decent editor; nicknames for quick addressing; broadcast mailings; the ability to send binaries; automatic handling of common Internet coding schemes, including Multipurpose Internet Mail Extensions (MIME); and Internet-style "signature" files. Additional features in the commer-

cial version include little touches like a second signature and extra configuration switches and major features like a filter for incoming mail, the ability to open text files and support for UU-code.

It's not difficult to learn *Eudora*, considering that it's such a comprehensive package. And it's quite easy to use once you've learned it.

There are some minor annoying glitches in *Eudora*. One is that it doesn't always pop up when you switch to it. You're forced to double click its icon after you've already used Alt-Tab. Another is that it doesn't use the Esc key as an equivalent of the Cancel button in dialogs. So, you're forced to use Ctrl-F4, repeated Tabs or a pointer. Another is that some windows don't have their own button, or their own menu. Instead, they rely on the main menu for this frequently-needed function. The program's interface would be improved by changing any of these things, but they're not essential. They just flatten the learning curve and force users to take a little longer than necessary to become familiar with the application. If I were cynical, I'd suspect Qualcomm of using this to help sell the well-documented commercial version of the product. But I don't honestly think this is its aim.

There are a couple of essential features I'd like to see added to *Eudora*. One is the ability to edit the files it lets you include in a letter. *Eudora* only adds text from files after you push the Send button. So, it's impossible to edit the text unless you first open your boiler-plate file (with an outside editor or word processor for the shareware version) and cut-and-paste the text manually.

There's one thing about *Eudora* that you're likely to find more annoying than it's missing features—the way its mailboxes are implemented. They're stored in an indexed file system, rather than as independent text files. The primary purpose of the index may be to support the program's excellent search and sort facilities. *Eudora* lets you search for text both in and across documents from the same dialog, and the sort algorithm is quite fast. However, the system's binary indexes, which reside in table-of-contents (TOC) files, also prevent you from modifying addresses or anything else in the Internet message headers except subject lines. This may be an oversight, but it seems more likely that it's intended to enforce ethical network behavior. (*Eudora* does make it possible to edit the subjects in this file, and it prevents you from easily modifying the content of files stored in it's mailboxes.)

In either case, it can have the effect of preventing modifications that would help you to file documents in a more-meaningful way. For example, I prefer to list the messages I forward to myself from a newsgroup by the name of the author, rather than by my own name. (Why would I send them to my mailbox, rather than simply saving them? So, I can make use of the mailboxes, search facilities and viewer, of course.)

Eudora's restrictions certainly help to enforce ethical behavior among those unwilling to decode the TOC files and write an editor for them. Enforcement might also be useful for the preservation of an audit trail. Nevertheless, it should be the choice of a system administrator—not the software vendor— whether or not to enforce something like this.

I hope Qualcomm and other Internet software developers learn about this type of policy from the experience of other mass-market software vendors. Microsoft DOS once tried to impose it's will on users in a similar way with its DEL and ATTRIB commands.

Inaccessibility of a file was supposed to be sacrosanct once it was consecrated to oblivion by the DEL or ERASE command. Similarly, Microsoft didn't want you seeing or manipulating its sacred hidden system files. Unfortunately, users sometimes deleted critical files unintentionally, and some software vendors in-

Bits & Pieces By Alexander W. Burawa

A number of items have come to my attention, one of which I thought should be brought to yours. One is of a nature that you wouldn't think to include it in your stock of computing paraphernalia—unless you suffer from any of a number of debilitating physical conditions that put a cramp on your mousing around and keyboarding. MouseMitt International's (75 Green Valley Rd., Scotts Valley, CA 95066; tel.: 408-335-9599; fax: 408-335-9598) MouseMitt wrist support takes the pain out of personal computing. At first, I didn't give much thought to this unassuming product, having tried a number of products to relieve the aching and cramping of my wrist while mousing around (I do more of this than I do keyboarding and, thus, have a problem only in the one wrist) without much success. In the months since I began using this uncomplicated and inexpensive thing, I can tell you that it has been both effective and convenient to use.

MouseMitt looks like a glove that has been short-changed of its fingers. It slips onto the hand in the same manner as a glove. It's constructed of a knitted fabric that feels comfortable while in place and has a thick cushioning bulge on the palm side that comes to rest against the wrist. The bulge is covered with a soft vinyl material that easily glides on any conventional work surface. The thickness of the cushion is perfect for mousing around. As you can see in the photo, the glove design keeps the cushion from riding up the arm or rotating around the wrist. Another nice thing about MouseMitt is that you don't have to remove it when writing—it doesn't get in the way and, in my case, actually makes writing by hand a less-tedious experience.

If you suffer from carpal tunnel syndrome or any of its related physical infirmities, or if you want to avoid such, you'll want to give MouseMitt a try. It's available in black, blue, teal, purple, gray and hot pink and comes in sizes ranging from extra-small to extra-large (the company provides a scale for determining the size MouseMitt you need). Price for a single MouseMitt for either hand is $9.95, and two MouseMitts, one for each hand, cost $19.95.

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correctly assumed that you'd never want to remove their hidden gems from your hard disk.

Peter Norton was one of the first to realize that users would pay to have Microsoft's unwanted restrictions removed, and he wrote his famous *Norton Utilities*. By and large, people don't want petty technocrats to limit their access to their own computer systems any more than they want petty bureaucrats to tell them how to run their lives. All such efforts ultimately fail. In the case of DOS, Norton made a fortune giving users an easy way to restore their deleted files, change the attributes of hidden and system files and access other areas of the system from which the developers of DOS thought the user should be protected.

Of course, with this access comes responsibility. You can hurt yourself if you're not careful. Certainly, Norton has a number of caveats, disclaimers and cautions about the risks of using his software. The savvy user does well to heed them. Nevertheless, the *Norton Utilities* have remained a great convenience to users long after their inventor has sold the company.

Getting back to *Eudora*, given that enhanced access is generally considered convenient, the lack of access must, conversely, be considered inconvenient. This is what *Eudora*'s enforcements are, flat-out inconvenient. Just to modify a file, you have to get into the mailboxes with an editor, which isn't easy. Since the corresponding TOC file maintains the length of each mailbox file, unless you can decipher and modify the TOC file, you must be careful to maintain the same file length. Unfortunately, headers are stored in the TOC file and, except for the subject line, can't be changed without somehow being deciphered first.

Eudora is a fine program, and its authors probably have noble intentions of preserving the integrity of e-mail. But no effort to prevent masquerading by playing net police is likely to stop anyone who's been a hacker longer than two minutes.

Strategies that offer a choice can be—and have been—used to provide security. One is to provide a configuration file for the exclusive use of system administrators. Header modifications can then be enabled or disabled, as desired, by the administrator and enforced by locking up the configuration file. I'd like to suggest that another acceptable way to provide an audit trail might be to keep a protected record of the header in the TOC and a second, editable, header for use in mailbox directories. This won't make masquerading any easier—or harder—for hackers, but it won't inconvenience legitimate users, either.

Contrast *Eduora* with the little mail facility in the *WinVN* interactive news-reader. *WinVN* allows you to edit the header with impunity. Not only can you control the subject line, you can swap the From: and To: fields so that *Eudora*'s mailbox directories display the name of a forwarded message's author, rather than yours.

• ***WinVN***. The Internet's major bulletin-board system is a vast source of information. There are currently more than 7,000 news groups on Usenet. Topics serve a wide range of interests, and many are quite useful. For instance, I was encouraged to subscribe to the *Olympia Review* sight unseen after being impressed by publisher McNeilley's own works in the rec.arts.poetry news group. Access to news groups requires a news-reader.

WinVN is, like *Eudora*, a popular piece of slasher software. That is, it's *Windows*-slash-Mac-slash-*X-Windows* software. It's also freeware. You don't have to pay for it because it's in the public domain. If you want to try it, just download the latest version by anonymous FTP from the site mentioned in the last GUI Guts.

WinVN isn't perfect, but it's a solid piece of beta software. Seldom, if ever, does it crash. Its feature set is robust. I've already mentioned the very-flexible mail function. It's quite handy to be able to send messages without switching applications. *WinVN* also has an automatic forwarding feature with it's own recipient list. The latest beta release (0.92.6+) preserves the subject line of the original message and adds an abbreviation to signify that it has been forwarded.

You can save articles directly to disk with *WinVN*, and the program automatically decodes images from single or multiple files, whether or not they're in proper order. It also skips through irrelevant text as easily as it does irrelevant files. The selection process is simplified by a search utility, as well as by the ability to automatically select all files that include a given search pattern in their subject lines. You can also sort by subject, threads (related articles), article number, author, date and article size. The one thing that's really lacking, in the way of downloading support, is batch-mode operation.

WinVN's support for posting messages to newsgroups is particularly impressive. It's ability to modify headers provides a simple, yet effective, mechanism for posting messages to multiple newsgroups, adding anonymous posting conventions, and a variety of other tasks. *WinVN* automatically incorporates reference headings into your articles, which it can later use to sort articles by threads. However, the most-impressive posting feature of the program is its massive arsenal of tools for posting graphic files.

WinVN automatically breaks images into multiple files of any size and encodes them according to any of several schemes, including the popular UU code. With *WinVN* you can include an attachment within another article or send it as a separate related article. I don't want this to sound like I'm picking on *Eudora*, but I should point out that, unlike *Eudora*'s practice of attaching files blindly, *WinVN* gives you a choice between posting attachments as they're being encoded or of previewing them first.

I've mentioned the internet's FTP file transfer protocol several times. I've also alluded to such other utilities as the file encoders that are required to send eight-bit binary files over the net's seven-bit pipeline. Applications like these are the keys to acquiring applications and other resources through the net.

Utilities that provide the FTP protocol, and such others as the Gopher file browser, are distributed on the Internet, just as are *WinVN* and the shareware version of *Eudora*. Another way to obtain this type of program is in commercial suites. Products such as the *Chameleon Sampler* and *Net Cruiser* combine these utilities with many others, conveniently and inexpensively.

Sampler, for instance, includes an FTP client for downloading files. In addition, *Chameleon* has its own WinSock protocol stack and clients for TCP/IP e-mail, Telnet (for remote access to private accounts), 3270 terminal, and Ping (a utility to confirm host connections). As I mentioned last time, this popular software is widely available in books like the Internet Starter Kit, in bundles like The Internet Membership Kit and even as part of the start-up package from service providers like Earthlink.

Client applications in *Sampler* are quite effective. They occasionally have features beyond those in their stand-alone competition. *Sampler*'s mail client, for example, has a mail filter that's included in only the commercial version of *Eudora*. It also allows you to edit included files—a basic capability that *Eudora* lacks. On the other hand, it doesn't let you sort mailboxes or search for text or messages. Both versions of *Eudora* have these extremely useful capabilities.

I might give *Eudora* a slight edge over *Chameleon* for its ease-of-learning. Unfortunately, it's difficult for me to be certain, given my greater experience with the Qualcomm product. This may also be the reason I prefer both the way *Eudora* works and it's configuration options. However, I'd give *Eudora* the edge for making better use of the GUI.

Sampler's mail client offers less ability to edit e-mail headers and text than *Eudora*. You can't change anything from

within the program. However, you can easily modify any part of the header or text with any editor. The difficult part is finding the right LTR file in the mailbox directory.

Sampler's best feature is Custom, a fairly stable WinSock stack, which can also support any of the *Windows* client software you find on the net. My only criticisms of Custom are that it takes forever to disconnect from the modem and that, when it does crash, you can't close *Windows* until you get rid of it's carcass. Sometimes you simply can't, forcing you to re-boot.

• **NCSA *Mosaic*.** I don't want to conclude this column without discussing at least one Web browser and making sure you know where to get it. There are several other *Windows* clients and another suite or two that I'll cover in a future issue as well. For now, the following should give you the basics you need to start on the Web.

NCSA *Mosaic* is undoubtedly the best-known browser on the net. There will soon be at least three other versions from NCSA licensees. All licensed versions provide the basic browsing services, but they all have value-added extensions as well. The following is based on the NCSA version.

I've mentioned in my last column that *Mosaic* is a browser for the World Wide Web's (WWW) hypertext environment. The Web is an intrinsically graphical environment and very demanding of computer resources. As a consequence, NCSA *Mosaic* has been created as a 32-bit application, which means you can't run it unless you have one of three *Windows* environments: *Windows* 3.1 with a WinSock-1.1-compliant DLL and the latest WIN32S extensions, *Windows for Workgroups* (3.11) with Microsoft's latest TCP/IP stack or *Windows NT*.

Fortunately, WIN32S is freely distributed to licensed users of *Windows* 3.1 and *Windows for Workgroups*. You'll find the file WIN32S115A.ZIP in the directory /DEVELOPR/WIN32DK/SDK-PUBLIC at Microsoft's anonymous-FTP server. However, WIN32S is also mirrored (as file WIN32S.ZIP) in the same directory you'll find Mosaic (file WMOS20A7.ZIP) at NCSA. This re-zipped version of WIN32S includes a README file prepared by NCSA. Get both files at ftp.ncsa.uiuc.edu in the directory /PC/WINDOWS/MOSAIC.

If you're downloading from an environment other than *Windows*, you may also require a *Windows* Socket TCP/IP stack. NCSA has the *Trumpet WinSock* (file WINSOCK.ZIP) in directory /PC/WINDOWS/MOSAIC/SOCKETS. NCSA even has the self-extracting file PKZ204G.EXE in the /PC/WINDOWS/MOSAIC/ZIP directory, just in case you don't have the latest version of PKWare's shareware utility. Special note: NCSA's anonymous FTP protocol expects you to respond to its password prompt with your Internet e-mail address.

Once you have *Mosaic* running, you'll find that it's just a matter of clicking on things to get information from the net. Pages are the basic unit of information access on the WWW. You can browse them and store their uniform resource locator (URL) addresses, to return there anytime. The program includes controls to navigate pages in either direction and the means to capture the URLs of the pages you view.

You can also save the pages themselves, both graphically, in their hypertext format, and as their underlying HTML (HyperText Markup Language) source code. Pages can also include hyperlinks that download binary files for you: images, sounds, animations, movies, software or any other. NCSA *Mosaic* doesn't include it's own file viewer, but it does provide the means of installing popular viewers like *LView* 3.1 or *LView Pro*.

Products Mentioned

WINProbe, $99
Landmark Research
703 Grand Central St.
Clearwater, FL 34616
Tel.: 800-683-6696 or 813-443-1331

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Eudora, $65
Qualcomm Enterprise Software Technologies
10555 Sorrento Valley Rd.
San Diego, CA 92121-1617
Tel.: 800-238-3672
E-mail: eudora-sales@qualcomm.com

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This should be enough to get started. Coming up, I'll take a look at several other World Wide Web browsers in more detail, some file viewers, *NetCruise*, and the additional clients in Internet *Chameleon*, the commercial *NetManage* product.

Industry Watch By John Hastings

The AmCoEx Index of Used Computer Prices

Intel is expected to cut the prices on its top-of-the-line Pentium CPU chips this quarter, but some industry experts think the cuts may be much deeper than previously expected. Sales of Pentium chips have fallen far below Intel's expectations. Most high-end machines have been sold into the home market, while corporate buyers have stayed away in droves.

In addition, Intel is facing more serious competition than it has seen in the past decade. The PowerPC chip, manufactured by IBM and Motorola, is gaining ground and respectability. But more importantly, Advanced Micro Devices, Cyrix and NexGen will have clones of the Pentium available in quantity this year.

Compaq will purchase all of the chips AMD can make and IBM will manufacture large quantities of the Cyrix chip. To make matters worse, 486 chips are less expensive and abundant. To retain market share, Intel will make radical price cuts in the near future. In the new market, 486 price cuts will be inevitable and in the used market, prices for 486 and 386 computers will fall sharply.

While the current version of the PowerPC CPU chip can outperform most Pentium-based computers, IBM and Motorola aren't resting on their laurels. The two companies were expected to announce the next generation of the chip late in 1994. The new version, known as the PowerPC 620, is expected to perform up to twice as fast as the existing chips. While Intel's Pentium sales have been below expectations so far, the new PowerPC chip will only make matters worse for Intel.

Motorola may be looking at Apple as an acquisition. As the manufacturer of all of Apple's CPU chips, Motorola has been disappointed that Apple hasn't licensed its operating system software to more computer manufacturers. By owning the company, Motorola could rectify this situation and create an enormous market for its PowerPC chips.

Meanwhile, IBM doesn't relish losing the PowerPC market to Motorola. By making a substantial investment in Apple, IBM can license the Macintosh operating system and help Apple defend itself from acquisition by Motorola. Look for IBM Macintosh clones by this summer.

Microsoft's new operating system was frequently called *Chicago* during its development phase, and until late last year, many people referred to it as *Windows* 4.0, the normal naming convention. Microsoft surprised the industry by announcing last November that the product name would be *Windows 95*.

Owing to delays in product testing, IBM is hoping the new name will be *Windows* 95½, since the software may not be available until the second half of this year. IBM hopes the delay of the new *Windows 95* will give its new *OS/2 Warp* operating system a boost. Some industry experts claim that the newest *OS/2 Warp* released in early November 1994 is the superior product.

While IBM's future rests on the OS/2 operating system, the current version is merely a springboard to the future. IBM is counting on the success of its PowerPC CPU chip for future profits. The chip will never reach IBM's sales expectations unless OS/2 is successfully converted to work on the new chip. The conversion effort is months behind schedule.

Suddenly, IBM is forming a much closer alliance with Apple Computer. Not coincidentally, Apple is the only company with proven expertise in converting an operating system to the PowerPC.

Many people feel IBM will not only license the Macintosh operating system but also receive significant assistance from Apple in its conversion of OS/2 to the PowerPC. In return, Apple will be able to incorporate OS/2 into its Macintosh computers, enabling them to run all *Windows* applications. Apple has attempted to incorporate *SoftWindows* to accomplish this in the past. But, this software emulation for *Windows* runs too slowly and lacks many standard capabilities.

Following Apple's lead, Compaq and Dell have indicated that they'll soon market new lines of notebook computers with exclusively color screens. Some experts in the industry are predicting the end of monochrome as soon as this year. They feel the quality of cheaper passive-matrix screens is good enough and inexpensive enough to eliminate monochrome. Improved battery technology is also a factor because color screens draw more battery power.

As new production facilities begin to produce large quantities of active-matrix color screens, prices of color notebook computers are expected to drop rapidly. While in short supply for the past two years, high-quality color screens have commanded a premium price. With the increased supply available, some people expect color notebook prices to drop by $500 or more by April of this year.

When Apple introduced its first personal digital assistant (PDA) last year, its sales fell below expectations. The hand-held Newton Message Pad was criticized for being too expensive at $999. Its handwriting recognition was faulty; its fax/modem was optional; and its software was limited. Some people feel Apple has now rectified all of these problems.

One model of the Message Pad now sells for only $349. This price includes a fax/modem, several excellent software applications and improved handwriting recognition. While the new handwriting recognition isn't perfect, it's greatly improved. Sales are finally taking off.

A new software product from Palm Computing called *Graffiti* offers near-perfect handwriting recognition for several types of PDAs. It's currently available for the Casio, Tandy and Sony products and will be available for the Newton Message Pad by the time you read this. The new software can recognize up to 30 words per minute. Many former critics of PDAs have become believers while testing *Graffiti*.

Prices For Used Computers as of November 1, 1994

Machine	Average Buyer's Bid	Average Seller's Ask	Close	Change
IBM PS/2 Model 70, 60M	$400	$675	$475	–25
IBM PS/1 486DX2/50, 253M	1,125	1,450	1,125	–75
IBM PS/2 Model 90, 160M	1,200	1,600	1,300	—
IBM ThinkPad 350C	1,900	2,400	2150	–50
IBM ThinkPad 700	1,000	1,700	1,250	+25
IBM ThinkPad 720	1,600	2,000	1,725	–50
AST 486SX/25, 170M	700	1,250	925	—
AST 486DX/66, 340M	1,350	1,900	1,450	+150
Dell 386/33, 100M	600	1,000	725	–25
Dell 486DX/33 240M	850	1,500	1,175	–25
Gateway 386/25, 80M	400	800	600	+25
Gateway 486/33 120M	800	1,200	975	+50
Clone Notebook 386SX, 40M	500	900	750-	50
Clone 386/33, 80M, VGA	450	900	650	–25
Clone 486/25, 120M, VGA	700	1,200	950	–75
Clone 486DX/33, 240M	800	1,425	1,175	+50
Compaq LTE 286, 40M	300	675	525	–25
Compaq Contura 320, 60M	500	1,000	925	+50
Compaq Contura 4/25, 120M	1,100	1,600	1,200	–100
Compaq Deskpro 386/20e, 100M	500	800	600	–50
Compaq Deskpro 486/33, 120M	1,100	1,650	1,250	+25
Mac Classic II, 80M	400	800	450	–25
Mac IIsi, 160M	600	900	700	—
Macintosh IIcx, 80M	400	700	450	–25
Macintosh IIci, 80M	600	950	650	–25
Macintosh IIfx, 80M	700	1,250	875	+75
Mac Quadra 700, 230M	1,100	1,600	1,375	+125
Mac Quadra 800, 500M	2,150	2,900	2,275	–75
PowerBook 140, 40M	700	1,100	875	+75
PowerBook 170, 40M	800	1,350	1,100	+175
PowerBook 180, 80M	1,200	1,700	1,600	–100
LaserWriterPro 630	1,500	1,975	1,575	–25
Toshiba 1900, 120M	1,000	1,700	1,050	–25
Toshiba 3200 SXC, 120M	1,850	2,950	2,250	–50
Toshiba 3300SL, 120M	1,050	1,600	1,125	–100
Toshiba 5200, 100M	850	1,250	900	–100
HP LaserJet II	350	850	600	–75
HP LaserJet IIIP	350	950	500	—
HP LaserJet III	650	1,000	700	—
HP LaserJet IV	900	1,300	1,000	+25

More News

Apple Computer seems to be making a successful transition to the PowerPC platform. While sales of its PowerMac computers were ahead of forecasts earlier in 1994, introduction of Microsoft's *Word* and *Excel* for the PowerMacs has caused sales of the new computers to skyrocket. Though Compaq Computer outsold Apple in worldwide units, Apple remained number one for units sold in the U.S. in the fourth quarter of last year. In fact, the single best selling model was the PowerMac 6100. It outsold the best-selling Compaq model by more than 50%.

Advanced Micro Devices is touting a new CPU chip that not only outperforms Intel's Pentium but may outperform Intel's next generation chips. Some industry experts are concerned that this leapfrog of the industry leader may lead to incompatibilities in the future. As long as the smaller chip makers have followed Intel's lead, compatibility was assured. However, it's unlikely that Intel will change its designs to be compatible with a smaller rival's lead.

Competition in the CPU chip industry may force Intel to accelerate mass production of its next-generation chip. Many industry analysts feel the semiconductor giant would prefer to extend the life of the Pentium CPU chip to maximize its profits before announcing its successor. However, competition may not permit this luxury.

The next generation Intel chip, known as the P6, may be available in large quantities by the middle of next year. The P7, successor to the P6, is expected to be a RISC-based chip due out during 1996. This places Intel on a collision course with Microsoft's next operating system, *Windows 95*. Some people now think the new operating system won't be available until late 1995. Since *Windows 95* won't work with RISC-based computers, the new operating system may have a short life. Microsoft hopes to make *Windows NT* available for all RISC-based computers.

Computer programs and data are expanding at an exponential rate, and the storage of this data has created a dilemma. Floppy diskettes have limited capacity and tape drives are slow and undependable. A new floppy drive may resolve the problem next year. The new diskettes can store more than 150M with data access close to that of hard disk drives. The new floppies are expected to sell for less than $5 each.

If this device doesn't become a standard soon, the industry may adopt recordable CD-ROM drives instead. While these 680M drives cost more than $20,000 each a few years ago, they fell to less than $2,000 during 1994. Several makers have now announced new drives for less than $1,500. Philips has stated it will sell a new recordable CD-ROM drive that will fit in a standard floppy-drive bay for less than $1,000 by Spring 1995. If 680M isn't sufficient storage, a high density CD-ROM drive specification is expected soon that would permit one CD to store 4G (4,000 megabytes) of data.

While computer speeds are increasing, the time required to get data from a hard drive remains fairly constant. This produces a performance bottleneck. A new type of memory called flash RAM may eliminate this bottleneck on future computers. By copying frequently-used data from hard drive to flash RAM, a computer can access the data up to 20 times faster than the fastest hard drives now available. The advantage of flash RAM over normal memory is that flash RAM retains its data when the power is turned off. However, memory can cost up to 100 times as much per megabyte as a hard drive.

While flash memory cost is comparable to conventional memory today, prices are falling fast. In 1993, the chips sold for $30 per megabyte. Last year, they were $20 per megabyte, and some industry experts believe the price will be below 50 cents per megabyte in five years. This is less than the cost of small hard drives today and comparable to the cost of large hard drives. The chips may fill the enormous gap between floppy diskettes and CD-ROMs.

Software companies today face the option of distributing their programs on 20 to 30 diskettes or using only 10% of the capacity of a CD-ROM. At 50 cents per megabyte, memory chips would be cheaper than the alternatives. In addition, purchasers could use the chips to expand the memory in their systems each time they purchase software.

Prices For Used Computers as of December 6, 1994

Machine	Average Buyer's Bid	Average Seller's Ask	Close	Change
IBM PS/2 Model 70, 60M	$400	$675	$450	–$25
IBM PS/1 486DX2/50, 253M	1,000	1,450	1,100	–25
IBM PS/2 Model 90, 160M	1,200	1,600	1,250	—
IBM ThinkPad 350C	1,900	2,400	2,150	–50
IBM ThinkPad 700	1,000	1,700	1,250	—
IBM ThinkPad 720	1,600	2,000	1,725	—
AST 486SX/25, 170M	700	1,250	875	–25
AST 486DX/66, 340M	1,250	1,750	1,325	—
Dell 386/33, 100M	600	1,000	700	—
Dell 486DX/33, 240M	850	1,500	1,100	–50
Gateway 386/25, 80M	400	800	625	—
Gateway 486/33, 120M	800	1,200	925	–25
Clone Notebook 386SX, 40M	500	900	725	—
Clone 386/33, 80M, VGA	450	900	650	–25
Clone 486/25, 120M, VGA	700	1,200	975	–25
Clone 486DX/33, 240M	800	1,425	1,125	—
Compaq LTE 286, 40M	300	675	400	—
Compaq Contura 320, 60M	500	1,000	900	–50
Compaq Contura 4/25, 120M	1,100	1,600	1,150	—
Compaq Deskpro 386/20e, 100M	500	800	650	—
Compaq Deskpro 486/33, 120M	1,100	1,650	1,100	–50
Mac Classic II, 80M	400	800	600	—
Mac IIsi, 160M	600	900	650	+25
Macintosh IIcx, 80M	400	700	400	—
Macintosh IIci, 80M	500	950	600	—
Macintosh IIfx, 80M	700	1,250	900	–25
Mac Quadra 700, 230M	1,100	1,600	1,400	+25
Mac Quadra 800, 500M	2,150	2,900	2,150	+50
PowerBook 140, 40M	700	1,100	850	—
PowerBook 170, 40M	800	1,350	1,100	–50
PowerBook 180, 80M	1,200	1,750	1,725	—
LaserWriterPro 630	1,500	1,975	1,550	—
Toshiba 1900, 120M	1,000	1,700	950	—
Toshiba 3200 SXC, 120M	1,850	2,950	2,050	–50
Toshiba 3300SL, 120M	1,050	1,600	1,100	—
Toshiba 5200, 100M	850	1,250	875	+25
HP LaserJet II	350	850	625	—
HP LaserJet IIIP	350	950	450	–25
HP LaserJet III	650	1,000	700	—
HP LaserJet IV	900	1,300	1,000	—

The next generation of flat-panel displays may appear on the market in less than two years. Known as Thin CRTs, these panels are expected to be less expensive and brighter than any on the market today. In addition, the new screens can be made in much larger sizes than current technology permits. Current LCD screens rarely exceed a 12" diagonal measurement. Initial use for Thin CRTs will likely be in portable computers. However, as prices for large screens fall, they may replace conventional monitors. Further refinement could open markets for large-screen TV.

Intel may change its famous slogan "Intel Inside" to "Intel Outside" soon. With diminishing business from IBM and Compaq and the smaller PC companies dying out, some people think Intel will begin selling its own brand of computers. Many think they could be the largest computer maker within two years.

IBM is teaming up with Hughes to distribute software by satellite. Using small pizza sized dishes similar to some new TV receivers, IBM hopes to distribute software to corporate customers and software retailers. Home users may soon purchase software over the same cable that will deliver interactive cable TV.

Since 1988, the American Computer Exchange has matched buyers and sellers of used microcomputer equipment. John Hastings is the president of the American Computer Exchange Corp., which has matched buyers and sellers of used microcomputer equipment since 1988. For more information, contact the American Computer Exchange Corp. at 800-786-0717. The Atlanta, GA, fax number is 404-250-1399

Computing On The Go

(from page 78)

crapped the "subnotebook" moniker).

The T3400CT sports a 33-MHz SL enhanced i486SX (3.3-volt) processor, 4M of RAM, a 120M hard disk, local-bus video and graphics accelerator and external 3½" floppy-disk drive. Some of these stats may be below par nowadays, but not the display. The 7.8" TFT-LCD active-matrix display is a joy to view and work with. The display is bright and sharp, has brilliant colors and operates very fast. This display alone makes the T3400CT an exceptional value.

Other features of this 4.4-pound notebook are a PCMCIA 2.01 Type II slot, parallel and serial ports at the rear of the computer and a proprietary 72-pin connector that can be used with an included video adapter to hook up an external monitor. Alternatively, the connector can be used with an optional port replicator (a mini docking station). You can't add an external keyboard unless you purchase the port replicator.

Software products installed on the system are DOS 6.21, *Windows* 3.11, *CommWorks for Windows* and *PhoenixCARD Manager Plus* Version 3.00.

The pointing device is a pointing stick titled the AccuPoint, which is similar to the pointing stick on IBM notebooks. Though I don't have a great deal of experience using the AccuPoint, it does seem like a convenient way to move around the mouse pointer.

Price of the T3400CT varies between $1,800 and $2,000, depending on the store offering it. This is a great value for a portable PC with an active-matrix display.■

Products Mentioned

Microsoft Workgroup Add-On for Windows
Microsoft Corp.
One Microsoft Way
Redmond, WA 98052
Tel.: 206-882-8080; fax: 206-883-8101
CIRCLE NO. 132 ON FREE INFORMATION CARD

Ether16 LAN Card (Combo RJ-45 & BNC)
Combo PCMCIA EthernetCard
Linksys
PO Box 18558
Irvine, CA 92713
Tel.: 714-261-1288; fax: 714-261-8868
CIRCLE NO. 133 ON FREE INFORMATION CARD

Toshiba Portege T3400CT
Toshiba America Information Systems, Inc.
9740 Irvine Blvd.
Irvine, CA 92718
Tel: 714-583-3000
CIRCLE NO. 134 ON FREE INFORMATION CARD

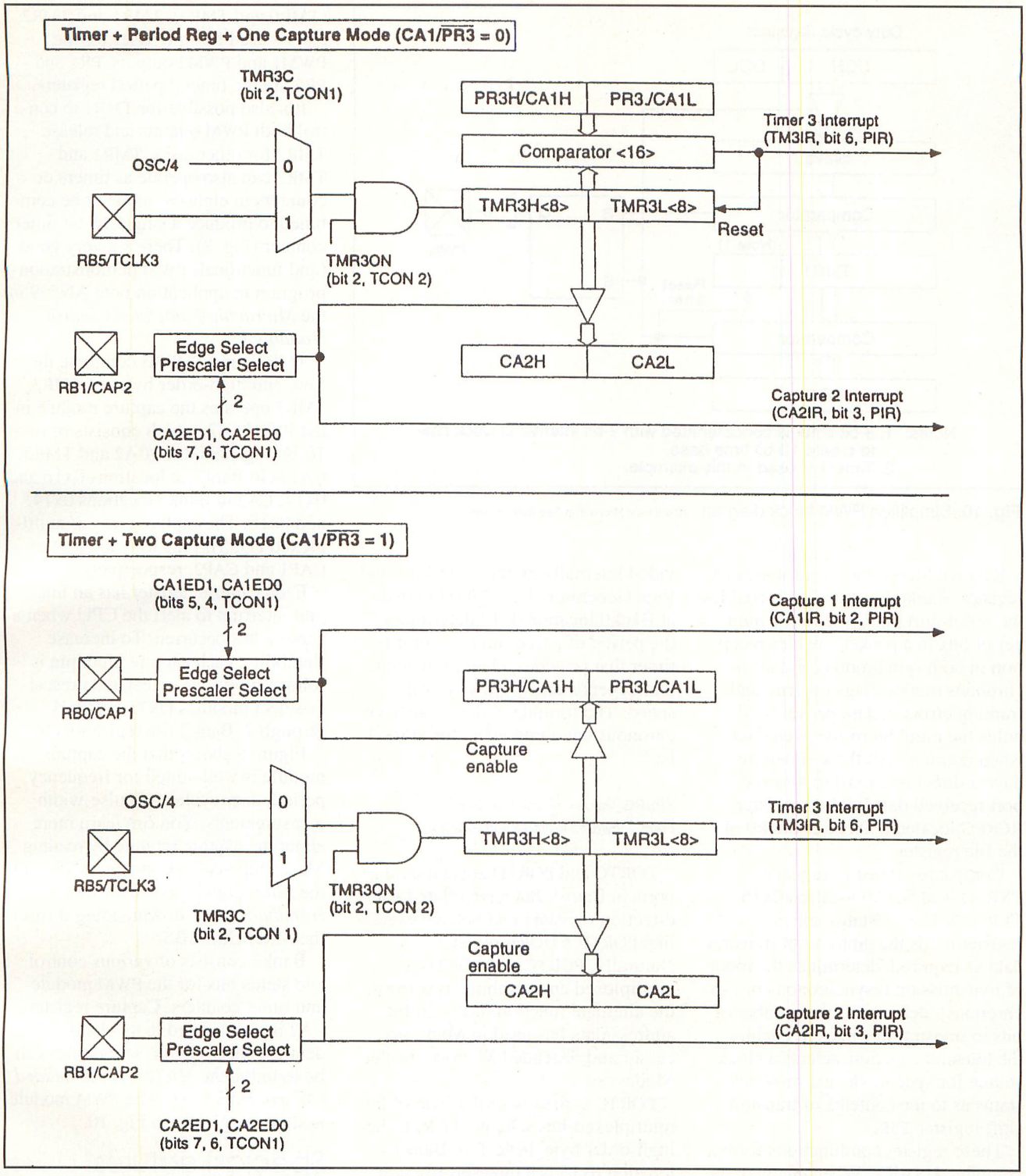


Fig. 9. TIMER3/Capture Module block diagram. (Courtesy Microchip Technology Inc.)

synchronous mode. RA5 is the TX (Transmit Data) pin in asynchronous mode and clock pin CK in synchronous mode. The active-high SPEN bit (Bit 7 of RCSTA) determines if RA4 and RA5 are configured as serial-port pins. Bit 6 of PORTA isn't used.

File register PORTB is at location 0x12 in Bank0. Its associated DDRB data-direction register is at 0x11. PORTB is bidirectional, with direction of data flow determined by the contents of DDRB.

To designate a PORTB pin as input, the corresponding bit position in DDRB must be set to 1. To activate an output pin, set the corresponding DDRB pin to 0. The PORTB weak pull-ups are disabled for any pin designated as an output.

Like those of PORTA, PORTB pins are multiplexed. RB0 and RB1 are alternate capture inputs. RB2 and RB3 are utilized as PWM (Pulse Width Modulation) outputs, and RB4 and RB5 can become inputs for Timer 1 and Timer 3.

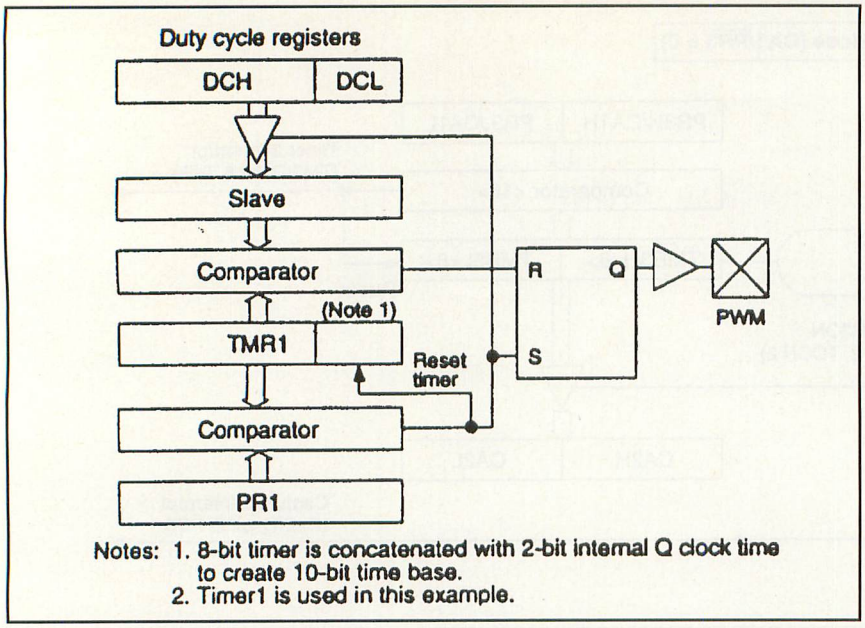


Fig. 10. Simplified PWM block diagram. (Courtesy Microchip Technology Inc.)

Receive Status and Control RCSTA register, Bank0 location 0x13, enables the serial-port pins, selects the number of bits in a packet, enables reception in both synchronous and asynchronous modes, flags overrun and framing errors in data packets and holds the ninth bit of received data when required. All these functions have a direct relationship to serial-port received data holding register RCREG located at 0x14 in Bank0 of the file register.

Companion transmit register TXREG is at Bank0 location 0x16. TXREG's TXSTA status and control register holds the ninth bit of transmit data as required, determines the mode of transmission (asynchronous or synchronous), determines the number of bits to transmit in a packet, enables the transmit function, selects a clock source for sync mode and provides status as to the contents of transmit shift register TSR.

These register combinations form a complete USART. When enabled, the serial port can operate in full-duplex asynchronous mode or half-duplex clocked synchronous mode. In full-duplex, data can be transmitted and received simultaneously. In half-duplex, only receive or transmit can occur at any given time but not simultaneously from either end of the link.

In synchronous mode, the clock can be internal or external. In asynchronous mode, the clock is always provided internally by the eight-bit Baud Rate Generator. The SPBRG register at Bank0 location 0x17 determines the period of a free running eight-bit timer that provides a baud-rate value that depends on processor clock speed. The formula to derive an asynchronous baud-rate value for SPBRG is:

SPBRG_Value = (Processor Clock Frequency/(64*Desired Baud Rate)) –1

PORTC and PORTD are standard I/O ports in Bank1 that have related data-direction registers that behave exactly like PORTB's DDRB register. Naturally, PORTC and PORTD are multiplexed and combine to perform the alternate function of the 16-bit address/data bus used in Microprocessor and Extended Microcontroller Modes.

PORTC is the low-order byte of this multiplexed-bus scheme, PORTD the high-order byte. PORTE in Bank1 location 0x15 is a three-bit I/O port that provides the active-high Address Latch Enable ALE, active-low Output Enable OE and active-low Write WR system bus functions to support the 16-bit address/data bus when it's activated. PORTE data-direction register DDRE is just ahead of the port latch itself, at location 0x14 in Bank1.

The PIC17C42 employs three 16-bit timers, two eight-bit timers (TMR1 and TMR2) and two 16-bit timers (TMR0 and TMR3). TMR1 and TMR2 can be used for timebases for the PWM1 and PWM2 outputs. PR1 and PR2 are the timers' period registers.

It's also possible for TMR1 to control both PWM outputs and release TMR2 for other tasks. TMR1 and TMR2 can also operate as timers or counters in eight-bit mode or be combined to produce a single 16-bit timer counter (Fig. 8). There's a very good (and functional) PWM demonstration program in application note AN539 in the *Microchip Embedded Control Handbook*.

TMR3L and TMR3H comprise the low- and high-order bytes of TMR3. TMR3 operates the capture module in the PIC17C42, which consists of two 16-bit registers, CA1/CA2 and TMR3. CA1 is in Bank2 at locations 0x16 and 0x17, CA2 in Bank3 locations 0x14 and 0x15. The capture pins are multiplexed PORTB pins RB0 and RB1 or CAP1 and CAP2, respectively.

Each capture register has an integral interrupt to alert the CPU when a capture has occurred. To increase flexibility, each capture input pin is followed by edge-select and prescaler-select modules (TCON1 Bits 4 through 7, Bank3 file register 0x16).

Figure 9 shows that the capture module is well-suited for frequency, period, duty cycle and pulse-width measurements. You can learn more about the capture module by reading Microchip application note AN545 in the *Microchip Embedded Control Handbook* or by downloading it from the Microchip BBS.

Bank3 consists of various control and status bits for the PWM module and timer counters. Capture register CA2 is also located in this bank. More details concerning these modules can be found in the *Microchip Embedded Control Handbook*. The PWM module is shown logically in Fig. 10.

Special Features

The PIC17C42 has an independently clocked Watchdog Timer (WDT) for added system stability and integrity. A built-in start-up timer is incorporated to permit sufficient time for the on-chip crystal oscillator to stabilize following power-up.

To provide power-supply stabilization, an on-board fixed 80-ms power-up timer (PWRT) keeps the PIC17C42 in reset while power is unstable. The

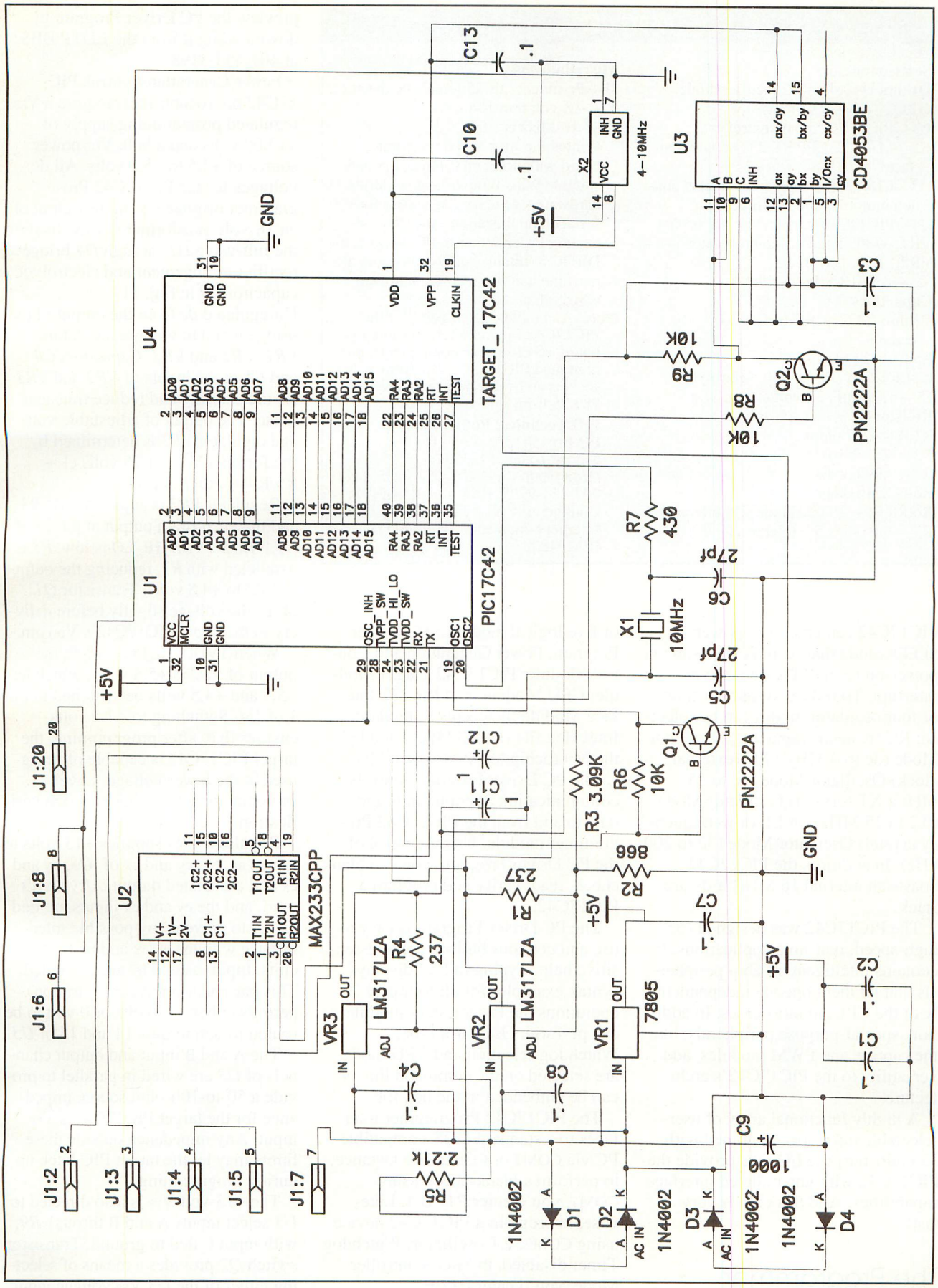


Fig. 11. Complete schematic diagram of PIC17C42 Controller circuitry.

PARTS LIST

Semiconductors
D1 thru D4—1N4002 rectifier diode
Q1,Q2—PN2222A transistor
U1—PIC17C42 microcontroller
U2—MAX233CPP RS-232 serial interface
U3—CD4053BE triple two-channel analog multiplexer/demultiplexer
U4—PIC17C42 (target chip; see text)
VR1—7805 fixed +5-volt regulator
VR2,VR3—LM317LZ
X2—4- to 10-MHz oscillator

Capacitors
C1 thru C4,C7,C8,C10,C13—0.1-µF ceramic disc
C5,C6—27-pF disc
C11,C12—1-µF, 35-volt electrolytic
C9—1,000-µF, 35-volt electrolytic

Resistors (1/4-watt, 1% tolerance)
R1,R4—237 ohms
R2—866 ohms
R3—3,090 ohms
R5—2,210 ohms
R6,R8,R9—10,000 ohms, 5% tolerance
R7—430 ohms 5% tolerance

Miscellaneous
J1—Pc-mount DB-25 female connector
T1—18-volt transformer
X1—10-MHz crystal
Printed-circuit board or perforated board with holes on 0.1" centers and suitable Wire Wrap or/and soldering hardware (see text); ZIF socket for U4; serial communication cable for connecting Programmer to PC; sockets for DIP ICs; suitable enclosure (optional); machine hardware; spacers; hookup wire; solder; etc.

Note: A complete kit of parts for the PIC17C42 Programmer, including pc board, all electronic components, programmed PIC17C42, transformer, IC sockets and software is available for $89.95 from

E D Technical Publications
PO Box 541222
Merritt Island, FL 32954-1222
Order/Help Line: 407-454-9905; fax: 407-454-9905; BBS: 407-454-3198; CompuServe No.: 75151,2735; Internet e-mail address: FEADY@IBM.NET.

PIC17C42 can enter low-power SLEEP mode that permits wake-up via power-on reset, WDT time-out or interrupt. To reduce system cost, one of four oscillator modes can be selected: RC (resistor/ capacitor) Oscillator Mode (dc to 4 MHz); EC (external clock) Oscillator Mode (dc to 25 MHz); XT (crystal) Oscillator Mode (0.2 to 25 MHz); or LF (low-frequency crystal) Oscillator Mode (32 to 200 kHz). In addition, the PIC17C42 boasts an internal 16 X 16 hardware stack.

The PIC17C42 was designed for high-speed, real-time applications. It contains intelligent on-chip peripherals that let them operate independently of the CPU, in most cases. In addition, special-purpose peripherals, like the capture and PWM modules, add versatility to the PIC17C42's architecture.

A highly functional array of user-selectable interrupts combined with 33 multi-purpose I/O pins provide the PIC17C42 with unparalleled interface capabilities. And this chip is very fast!

The Programmer

The PIC17C42 Programmer consists of five logical modules: PC Driver Program; Power Generation and Control Module; PIC17C42 Target Module; CPU Module; and RS-232 Interface Module. It accepts a standard Intel Hex file (INHX8M) created by the Microchip MPASM Assembler.

The PC Driver Program controls communication of commands and data to and from the PIC17C42 Programmer module. Under control of the PC Driver Program, you can blank check, read, verify and program a PIC17C42.

The PC Driver Program is easy to use and contains built-in context-sensitive help. Typing in P17 displays syntax examples for all four of the operations the Programmer module can perform. Oscillator type, Watchdog selection and CPU mode are selected on the command line or can be embedded in the hex file.

The PIC17C42 Programmer interfaces to a standard DOS-compatible PC via COM1 or COM2. For instance, to perform a blank-check using COM1, you'd enter P17 B 1. Likewise, to program a PIC17C42 device using COM2, XT oscillator, Watchdog Timer disabled, in Microcontroller Mode, you'd enter P17 P <filename.hx8> 2 XT 00 MC. You can preview the PC Driver Program by downloading it from the EDTP BBS at 407-454-3198.

• **Power Generation/Control.** PIC-17C42 microcontrollers require a V_{PP} regulated programming supply of +13.00 volts and a bulk V_{DD} power source of +4.5 to +5.5 volts. All dc voltages for the PIC17C42 Programmer originate from the output of an 18-volt transformer (ACIN) feeding the full-wave *D1* through *D4* bridge rectifier arrangement and electrolytic capacitor *C9* in Fig. 11.

Unregulated dc from the output of the bridge is fed to voltage regulators *VR1*, *VR2* and *VR3*. Capacitors *C4* and *C8* at the inputs of *VR2* and *VR3* ensure stability and reduce transient noise. The output of adjustable voltage regulator *VR3* is determined by the formula V_{out} = 1.25 volts (1 + R5/R4) + R5(150 µA).

Regulator *VR2* is adjustable via *R3* and the open-drain output at pin 24 of *U1*. When TVDD_HI_LO is low, *R3* is paralleled with *R2*, reducing the output of *VR2* to +4.8 volts. Transistor *Q1* drops the voltage slightly before delivery to the target PIC17C42's V_{DD} pin.

When TVDD_HI_LO is high, the output of *VR2* is +5.8 volts, which lets +5.5 and +4.5 volts be switched to pin 1 of *U4*. Switching to +4.5 volts ensures that, after programming, the target PIC17C42 is capable of being used at the lower voltage. Level switching occurs during program verification.

Regulator *VR3* supplies +13 volts to inputs ay, by, cy and cx of *U3*. cy and cx and associated output cx/cy aren't used, and the cy and cx inputs are tied to V_{PP} to prevent any possible interference with the ay/ax and by/bx circuits. Inputs ax and bx are grounded. This particular input configuration permits either +13 volts or 0 volt to be routed to output pins 14 and 15 of *U3*.

The A and B input and output channels of *U3* are wired in parallel to provide a 50-to-100-ohm source impedance for the target PIC17C42's V_{PP} input. Any impedance outside these limits may let the target PIC latch up during programming.

The +13-volt V_{PP} is also directed to *U3* select inputs A and B through *R9*, with input C tied to ground. Transistor switch *Q2* provides a means of selecting either of the *U3* V_{PP} voltage input pairs, ax/bx or ay/ by, to be routed to

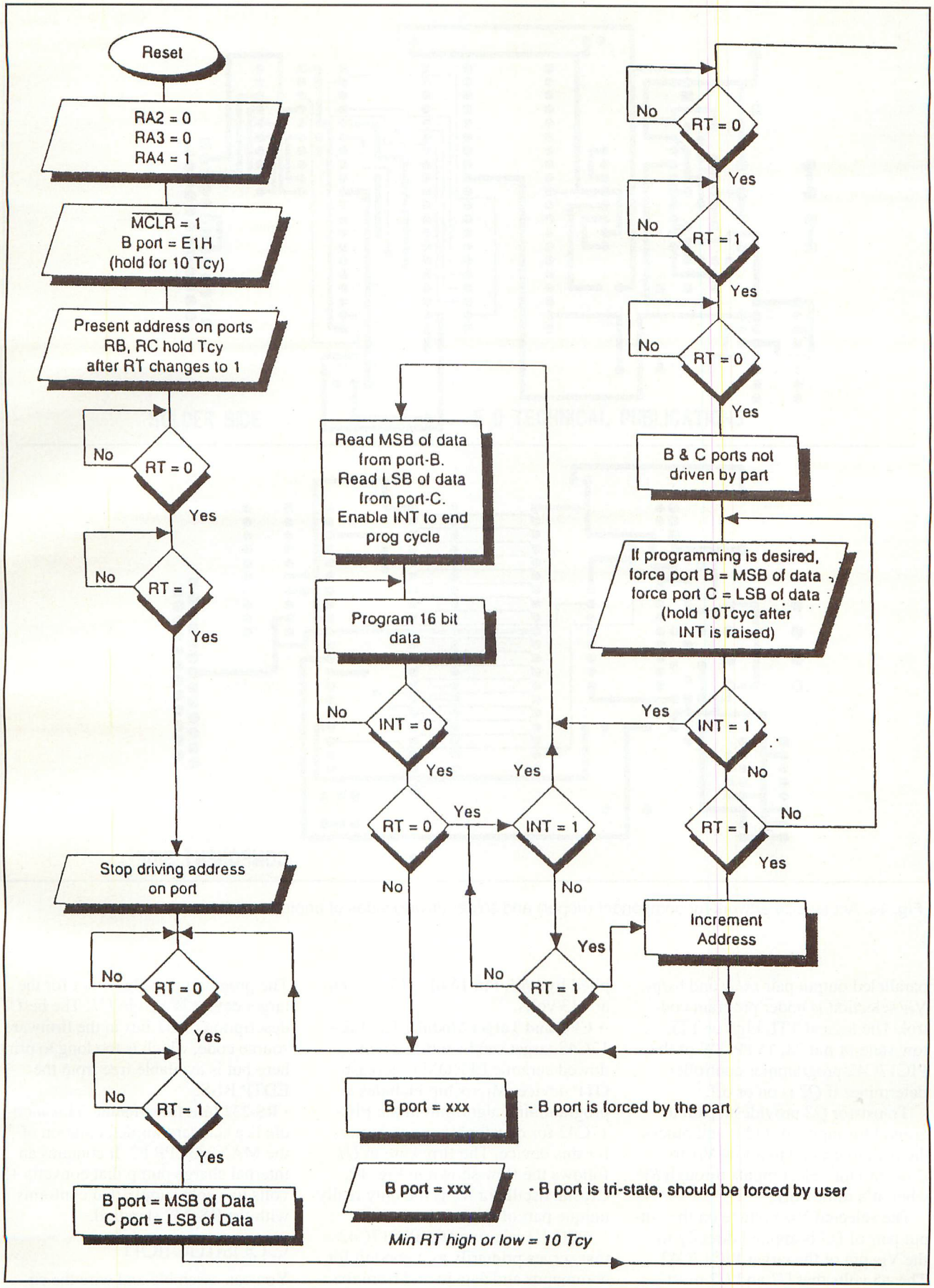


Fig. 12. Programming routine flowchart for PIC17C42 microcontroller. (Courtesy Microchip Technology Inc.)

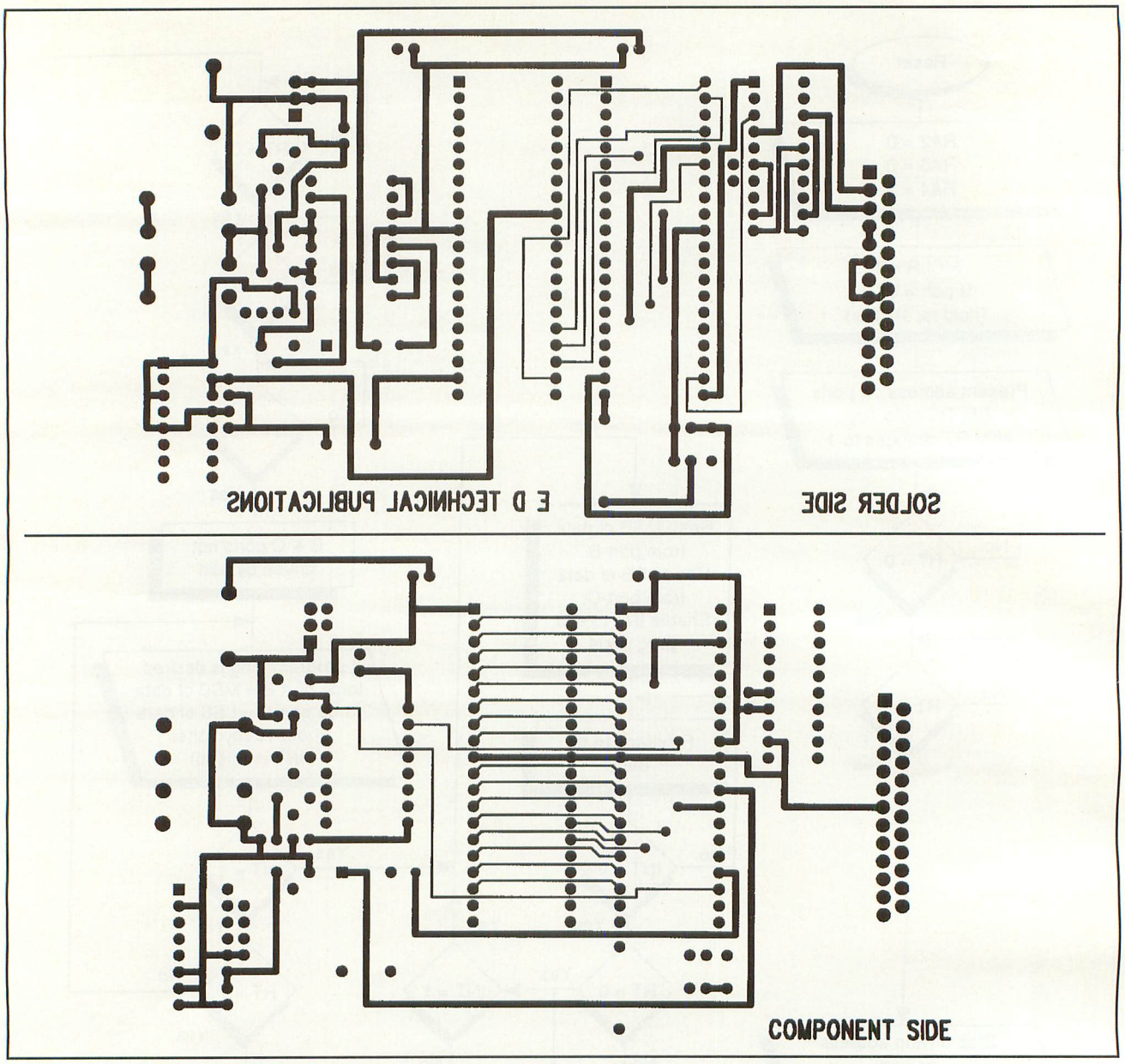


Fig. 13. Actual-size artwork for component (upper) and solder (lower) sides of printed-circuit board.

paralleled output pair ax/ay and bx/by. V_{PP} selection is under program control. The logical TTL high or TTL low state of pin 28, TVPP_SW of the PIC17C42 programmer controller determines if *Q2* is on or off.

Transistor *Q2* provides a path to ground for inputs A and B and blocks the path to ground to allow V_{PP} to flow into the select inputs through *R9* when it's turned off.

The selected V_{PP} voltage on the output pair of *U3* is applied directly to the V_{PP} pin of the target PIC17C42. The +5 volts that *U1* and *U2* must have during normal operation is supplied by *VR1*. Pin 16 of *U3* is driven at +13 volts.

• **CPU and Target Module.** The PIC-17C42 target can be either a windowed ceramic EPROM or a plastic OTP device. Microchip includes a programming algorithm in the PIC-17C42 for developing programmers for this device. The firmware in *U1* follows the flow shown in Fig. 12. Crystal oscillator *X2* is the only really unique part of this module.

CPU *U1* is a standard PIC17C42 that serves primarily as a conduit for commands and data to and from the PC's serial port and Driver Program. The programming algorithm for the target device is also in *U1*. The best description of *U1* lies in the firmware source code, which is too long to print here but is available free from the EDTP BBS.

• **RS-232 Interface Module.** This module is a standard implementation of the MAX233CPP IC. It contains an internal charge pump that converts +5 volts to a split supply that conforms with the RS-232 standard.

Construction

You can assemble and wire the circuitry for the Programmer on a dou-

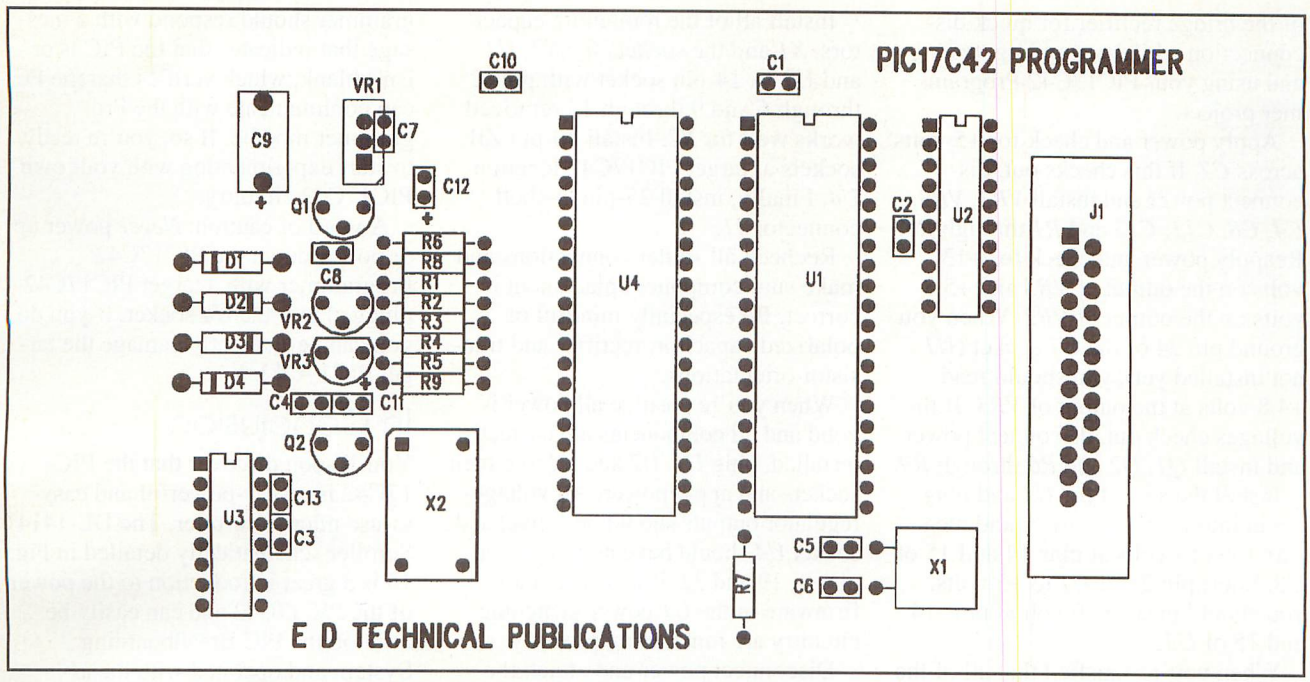


Fig. 14. Wiring guide for printed-circuit board.

ble- or single-sided printed-circuit board. Actual-size etching-and-drilling guides are given in Fig. 13. If you prefer not to fabricate a board, a silk-screened, double-sided one with plated-through holes is available from the source given in the Note at the end of the Parts List.

Another alternative is to wire the circuit on perforated board that has holes on 0.1" centers, using suitable Wire Wrap and/or soldering hardware. If you decide to make a single-sided pc board, etch and drill the solder side and substitute hookup wire for the conductors shown for the component side in Fig. 13.

Referring to Fig. 14, begin construction by wiring the Power Generation Module, installing *D1* through *D4*, *C9*, *C7* and *VR1*. Radio Shack Mini Test Clips (Cat. No. 270-372) work well as temporary and permanent connectors for the 18-volt transformer. Simply attach a pair of mini clips to the transformer's secondary and then clip on to the ac side (ACIN)

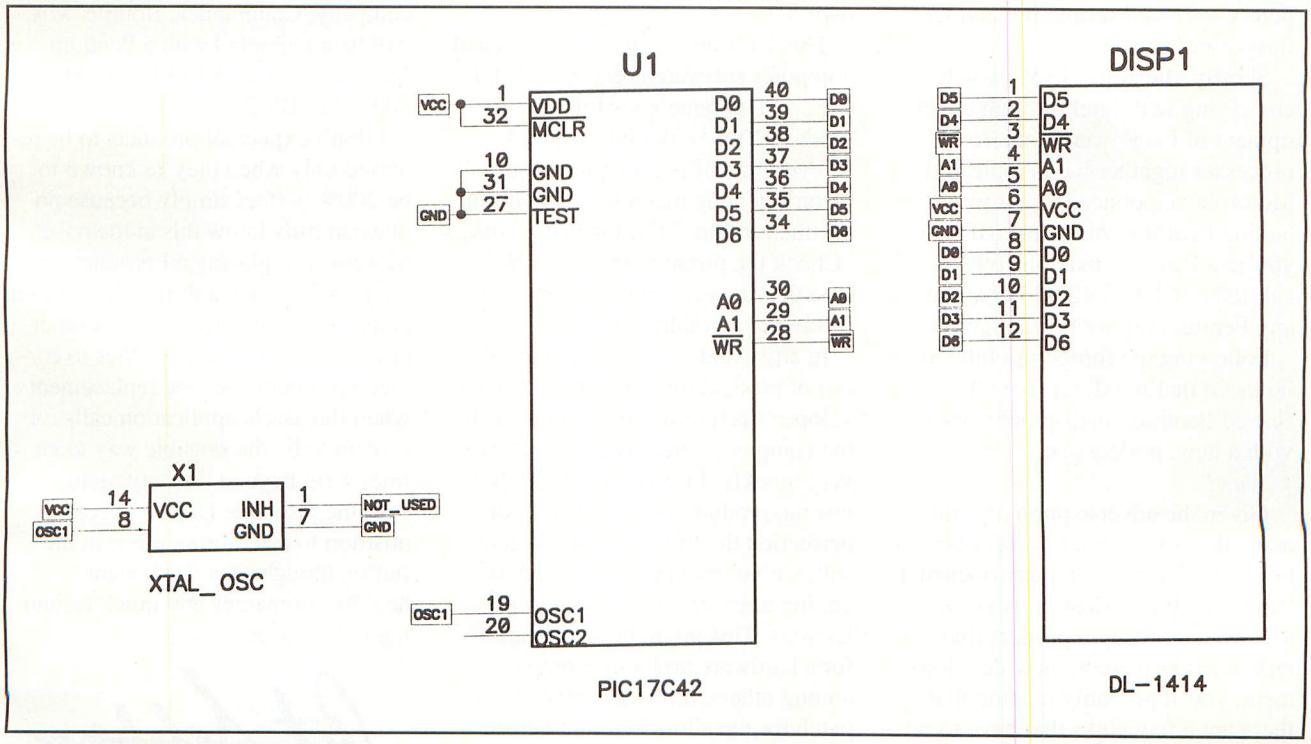


Fig. 15. DL-1414 Scroller details for experimenting with the PIC Programmer.

of the bridge rectifier for quick disconnection while assembling, testing and using your PIC17C42 Programmer project.

Apply power and check for +5 volts across *C7*. If this checks out, disconnect power and install *VR2*, *VR3*, *C4*, *C8*, *C11*, *C12* and *R1* through *R5*. Reapply power and check for +13 volts on the output of *VR3* and +5.8 volts on the output of *VR2*. When you ground pin 24 of the *U1* socket (*U1* not installed yet), you should read +4.8 volts at the output of *VR3*. If the voltages check out, disconnect power and install *Q1*, *Q2* and *R6* through *R9*.

Install the socket for *U3* and plug *U3* in into it. Apply power and measure for +13 volts at pins 14 and 15 of *U3*. Short pin 28 of *U1* to +5 volts, you should measure 0 volt at pins 14 and 15 of *U3*.

When you're satisfied that all of the power circuitry is operating properly, apply power and ground pin 23 of *U1*. Check for 0 volt at pin 1 of *U4*. Power down and disconnect power and all test jumpers.

Install all of the remaining capacitors, *X1* and the sockets for *X2*, *U1* and *U2*. A 14-pin socket with pins 2 through 6 and 9 through 13 removed works well for *X2*. Install 40-pin ZIF sockets at target PIC17C42 location *U4*. Finally, install 25-pin D-shell connector *J1*.

Recheck all solder connections and make sure component placement is correct. Be especially mindful of polarized capacitor, rectifier and transistor orientations.

When you're positive all power is good and all components are correctly installed, plug *U1*, *U2* and *X2* into their sockets and apply power. All voltage-regulator outputs should be active, and socket *U4* should have no voltage on pins 1, 19 and 32. If this is so, the firmware in the *U1* power-switching circuitry are functioning properly.

Disconnect power and attach the Programmer to your PC's serial port via a standard 25-pin cable. Do *not* plug a target PIC17C42 into the *U4* socket. Apply power and issue a blank-check command. The Programmer should respond with a message that indicates that the PIC is or isn't blank, which verifies that the PC can communicate with the Programmer module. If so, you're ready to start experimenting with your own PIC17C42 circuitry.

A word of caution: *Never* power up or power down the PIC17C42 Programmer with a target PIC17C42 plugged into the *U4* socket. If you do, you can permanently damage the target PIC17C42.

In Conclusion

You'll soon discover that the PIC-17C42 is a very-powerful and easy-to-use microcontroller. The DL-1414 Scroller schematically detailed in Fig. 15 is a great introduction to the power of the PIC17C42 and can easily be built on the PIC Breadboarding System and operated with the assembly-language program given in Listing 1. For programming examples, be sure to dial the EDTP BBS and check out the PIC17C42 application software offered there. ■

Editorial *(from page 4)*

ery because Pentium-equipped computers were still selling hot and fast, flaw or no.

Shortly afterward, IBM, which is competing with Intel through development of the PowerPC microprocessor together with Apple and Motorola, announced that it was halting Pentium shipments. (If you're a Pentium-machine owner, call IBM at 1-800-426-3389 about any Pentium questions you have.)

Following the foregoing, Intel announced that it will replace all flawed Pentium microprocessors with a new, perfect one.

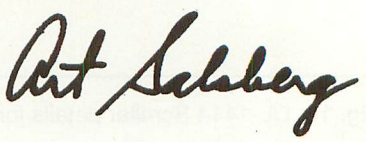
Wow!

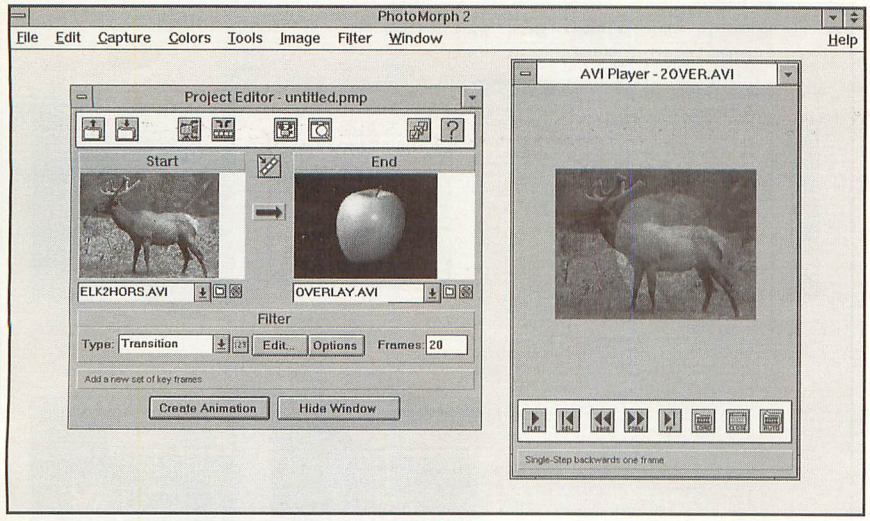
Given the adverse publicity, Intel made the correct final move, I believe. But has the company opened a Pandora's Box? Most of us know that when you buy a product that represents a spanking new development, you'll probably (a) find that there are a few kinks that have to be corrected and (b) you'll pay top dollar to be the first kid on the block to own it.

This isn't limited to computers and computer software (version 1.0, 1.1, 1.2,...). The same goes for new car models. You've doubtless heard: "Never buy a first-year automobile," "Don't get one that's from the initial production line." Or, for that matter, "Check the production date to be sure that it wasn't released on a day following a holiday.")

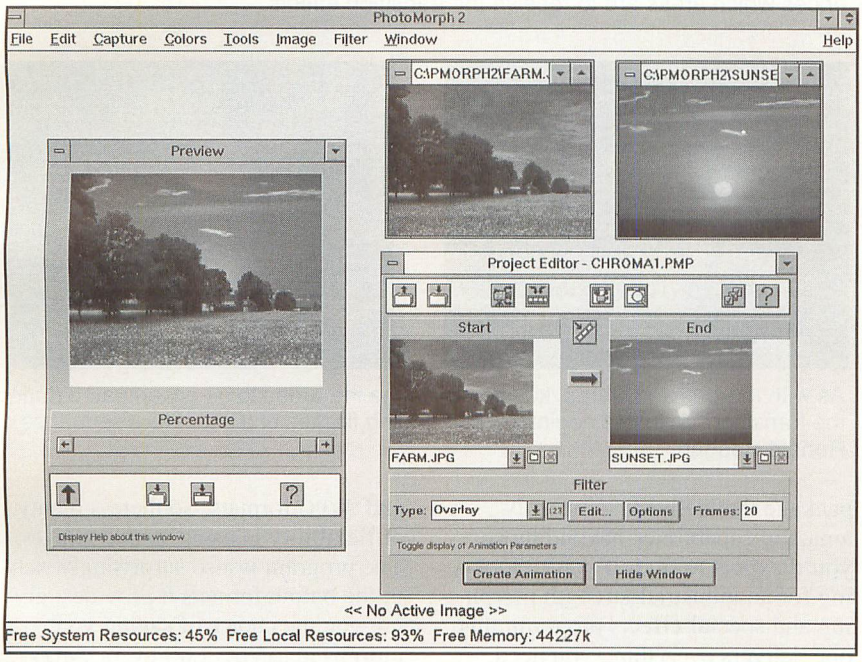
In any event, we haven't heard the last of product flaws in terms of a developer's responsibility to a buyer. In the computer field, inventions come very quickly. In spite of lengthy Beta testing, products often fall short of perfection the first time out. As a result, we've become accustomed to getting upgrades that correct imperfections. This might be a software fix for a hardware problem. Compaq, among others, offered a software patch for the ailing Pentium before Intel's free replacement decision was made. Also, an OEM development company, Communica, Bourne, MA, will be going retail with a Pentium software fix. Call 800-FIX-A-586 or 800-2-FIXBUG.

I don't expect all products to be released only when they're known to be 100% perfect simply because no one can truly know this at the onset. Moreover, replacing all products that are found to have a minor flaw could bankrupt a company. In the computer field, free software patches to correct a problem and free replacement when the user's application calls for it seem to be the sensible way to go. Intel went beyond this, owing to extreme pressure. Don't expect this position to be commonplace in the future, though. Not if we want healthy companies and quick technological advances.





Transitions, such as overlays between two video segments, make it possible to create intricate and exotic sequences. With such capabilities, you can create two individual morphing sequences, save them each as individual .AVI or .FLC animations and then meld them together to produce a final composite animated sequence. With capabilities like these at hand, you're limited only by your imagination.



Such high-end special effects as blue screening and chroma-keying are included in *PhotoMorph* 2's capabilities. In this example, color values of the sunset sky scene are chroma-keyed onto the pasture scene, with the resulting animation showing a "time-lapse" effect of the sky going from a deep blue at midday to the red-orange hues of sunset.

where changes in the curve are desired, entering as few points as possible to define a curve.

Digital Morph is also excellent for creating warp effects. It has a grid that overlays the image to be warped. The spacing of the grid points can be selected from choices of small, medium, large or custom. Custom setting lets you specify the grid point spacing in pixels, as you desire.

By pushing or pulling the intersecting points of the grid, you affect the distortion of the image underlying it. Several screen preview modes are available, and the visual feedback of moving grid points is immediate so that you can see what the resulting distortions will be. An Undo function makes it easy to correct anything you don't like.

Output choices for warp sequences are the same as those offered for the morphing functions, permitting you to save the animation as a *Windows* .AVI or AutoDesk .FLC file or as a series of individual images.

Digital Morph is a robust package that has a surprising assortment of high-end features and capabilities. The learning curve is fairly shallow, thanks to its conformation to standard *Windows* conventions and toolbar layouts. The extra features it provides via the Brush and Cutout menus justify the additional cost of this package.

PhotoMorph 2

An intriguing package from North Coast Software, *PhotoMorph* 2 is a powerful morphing program that runs under *Windows* and has an outstanding assortment of special-effects tools that go far beyond basic morphing and warping capabilities. With this package, you can truly create many of the special effects used in Hollywood movies and TV commercials that aren't possible with other morphing software products.

In addition to the morphing, warping distortion and transition effects you'd expect to find in a high-end product like this, you get several bonus capabilities, including blue-screening, chroma-key and alpha channel, which enable you to drop a selected image on another so that it looks perfectly natural. An example of this was the scene from *E.T.* in the bicycle basket riding across the sky with the moon in the background. Anyone who has taken the Universal Studios tour has seen how this is done, using the blue-screen technique. *PhotoMorph* 2 endows you with the same capabilities for your desktop video productions and still-image work.

Another neat feature of the program is the ability to colorize and tint video clips to make them look like colorized versions of black-and-white movies or to give them the sepia-tint of old-time photos and movie clips.

If you're involved in the commercial aspects of multimedia, you'll also appreciate the software's capability for creating storyboards and chaining together multiple clips for complex productions.

Additionally, an autoplay feature lets you construct multi-animation presentations, and a surprisingly complete image-editing facility lets you crop, rotate, scale and title the source imagery.

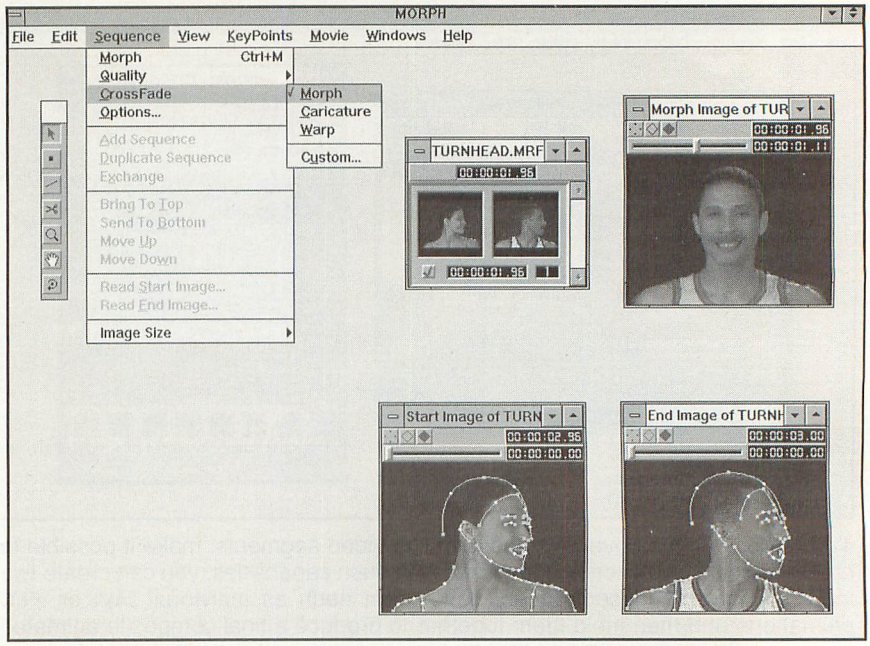
This program also provides excellent image-import capabilities, with 15 types (.AVI, .PCX, .GIF, TGA, .TIF, .BMP, .JPG, OS/2 .BMP, Macintosh .PCT and Amiga .IFF) supported. Output formats include *Video for Windows* .AVI, AutoDesk .FLC or individual 24-bit frames. A runtime copy of *Video for Windows* is included so that you can distribute your movies as .AVI animations.

This package is particularly well-suited for creating special effects for use with multimedia video presentations. It's equally strong for adding special effects to existing .AVI and .FLC sequences. Among the myriad transition effects available (there are 256,000 combinations in all), some of the most-useful are those that permit you to overlay and combine sequences. Such capabilities make it a snap to gradually fade-in titling, captions, text or graphics over running video segments and then to gradually fade them out again. By doing this with several small segments and combining them, you can achieve a seamless sequence that really looks as though it was done by a professional post-production facility.

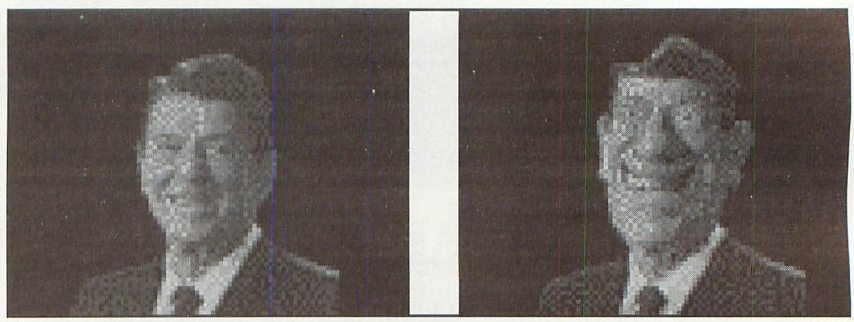
With the program's advanced special-effects capabilities of blue-screening and chroma-keying, you can select specific portions or tonal values of one image to affect portions of another image. Blue-screen and chroma-key effects are commonly used on TV news broadcasts, the best example being that of the local TV weather forecast.

The weather forecaster stands in front of a plain blue wall and points to different geographic areas, while the radar weather map of the U.S. is chroma-keyed onto the blue areas of the shot with the forecaster. The result of combining the two images is the illusion that the forecaster is actually pointing to a radar map on the wall behind him when, in reality, the map exists only electronically. (He uses a TV monitor out of view to show him the map image to orient his hand movements.)

PhotoMorph 2 is an easy-to-use package that delivers some truly amazing capabilities beyond those you'd expect to find. If you're looking for an industrial-strength morphing and special-effects program, this one delivers everything you need.



Morph 2.5 provides the option of generating morphs, warps or caricatures. Defining corresponding key points and key lines in the starting and ending images influences which areas are to receive the transition effects.



As with morphs and warps, key points define the areas to be accentuated during the transition, as in this beginning and ending frames of a caricature sequence of Ronald Reagan.

Morph 2.5

Gryphon's *Morph* was another early entry into this genre of software. The original version quickly established itself as one of the better packages, owing to its highly-intuitive interface and excellent complement of features. Gryphon has taken a good thing and made it significantly better with *Morph* 2.5.

The package's 15 image-type import capabilities include .BMP, .DIB, .DCX, .FLC, .FLI, .GIF, .JPG, .PCT, .PCX, .MOV, .TGA, .TIF, .AVI, .WMF and .WPG formats. So there's plenty of flexibility in using source images. The program is also surprisingly rich in the output formats it provides, giving you the choice of saving your morphs in .AVI, .FLI/.FLC or .MOV animation files or as individual-frame series in .BMP, .DIB, .DCX, .EPS, .GIF, .JPG, .PCX, .PCT, .TGA, .TIF (standard and .LZH) or .WMF formats.

While the documentation for *Morph* 2.5 is excellent, the program's interface is so intuitive that most users can probably create a morph sequence within a few minutes of loading the software without even referring to the manual. However, since the program offers lots of options and advanced features, the manual proves to be invaluable for getting the most from this package.

Morph 2.5 has become my favorite package for most of my multimedia morphing applications. It also has the singular distinction of having been used in such movies as *The Shadow, Dracula* and *Robin Hood: Men in Tights,* as well as having been used by *Time Magazine* in an article on immigration in the U.S. by morphing between men and women of different ethnic groups to illustrate what their progenies might look like.

Morph 2.5 combines ease of use with professional-caliber features and capabilities. So it's an excellent choice for either novice or users with advanced multimedia production needs.

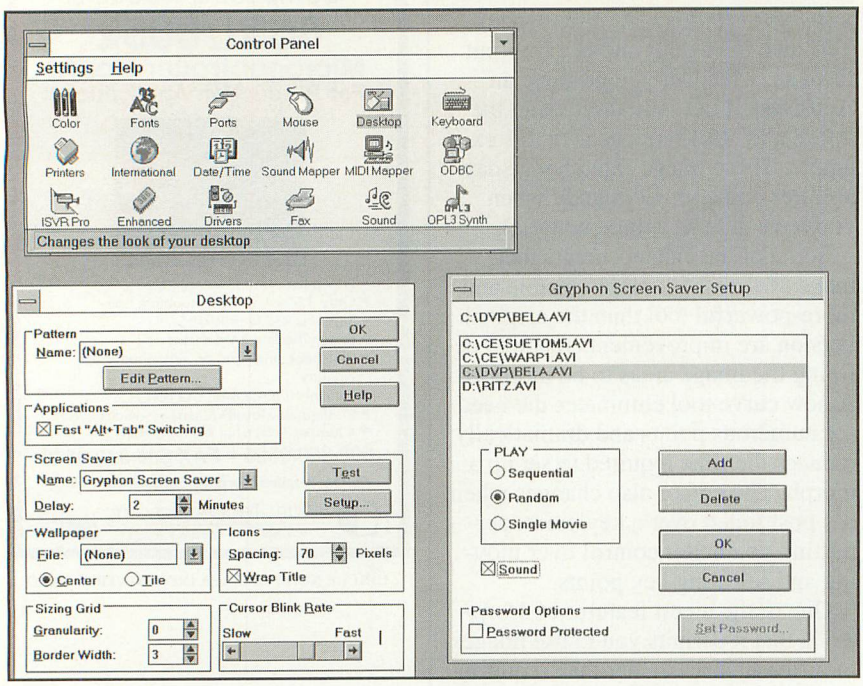
In addition to generating morph and warp sequences, *Morph* 2.5 provides the capability to generate caricature sequences by defining areas desired for accentuation. As with morphing and warping sequences, areas of transition for caricature sequences are defined using key points and lines.

The program also has the ability to create dynamic morphs from two separate animations, and their formats can be freely intermixed (for example, a *QuickTime for Windows* .MOV sequence dynamically morphed to a *Video for Windows* .AVI sequence). You also have your choice of output formats, which let you produce an AutoDesk .FLC animation using the .MOV and .AVI sequences in this example. These image-interchange capabilities come in very handy when you have diverse source material.

Some of the enhancements that make *Morph* 2.5 a more-capable and more-powerful tool than the original version are improvements made to defining the image areas to be morphed. A new curve tool eliminates the need for numerous points and dramatically reduces the time required to set up a morph. The cursor also changes when it's positioned over a key point, permitting you better control over moving and selecting key points.

One of the nicest features of *Morph* 2.5 is that it permits you to use images of different sizes, rather than requiring both starting and ending images to be the same size, as in the earlier version (as well as with some of the other morph packages). The standard tool complement includes a cropping tool that permits you to select an area of an image you want to morph.

There are other unique features of



Morph 2.5 gives the option of installing the ScreenSaver utility into your desktop control panel. Once installed, you can have your favorite morph sequences play as they save your CRT from image burn-in.

Morph 2.5 that set it apart from the other packages covered here as well. Once you've created an animation sequence, you can print an old-time flip-book of each individual frame of the sequence. You can cut apart the images and flip through the frames to see the animation unfold before your eyes. These flip-books are excellent for demonstrating animation, and they're good for sharing animations with your friends—and no computer is needed!

You can save a favorite morph movie as a screensaver, too. During installation of *Morph* 2.5 you're given the choice of installing the screen-saver module that, if selected, endows the standard *Windows* screen saver with the capability of playing .AVI or .MOV sequences. The setup screen gives additional configuration options, such as sequential or random play for multiple sequences, password protection and inclusion or exclusion of sound playback from the sequences. This screen-saver option is a very nice bonus to a package that's already an excellent all-around morphing value.

Other Morphing Goodies

Two morph movie collections on CD-ROM include numerous excellent examples of what you can do with Gryphon's *Morph* and North Coast's *PhotoMorph* 2 (see my Multimedia Column in this issue for more information on these two CD-ROM packages).

To get the most out of morphing, you need some means of getting source images into your computer. For this task, you may want to use a scanner (either hand-held or full-page) or an image-capture card that lets you grab images from a camcorder, video recorder or laserdisc player. I use a capture card for most of my work since most of my source material is already on video, rather than being printed images.

A good photo-retouching package is also essential for cropping, cleaning up and modifying source images. I use several different packages, but I recommend that you use whatever package you feel most comfortable with and that can do the job you require.

Once you've completed your morphed sequences, you may want to transfer them to videotape for distribution or for sharing with friends. Several different cards are available for overlaying and exporting computer imagery, including the new internal Studio Magic for Windows Card (and Digital Vision's external TelevEyes Pro (also reviewed in my Multimedia column in this issue).

In Closing

Morphing is creative and fun to do, and you can do some absolutely incredible things with the packages I've reviewed here. With some imagination, planning and time, you can create morphed and warped sequences that will amaze and delight all who see your work.

In addition to the recreational, entertaining and fun uses for morphing I've touched upon here, there are some serious applications for which it can be used, such as aging or modifying a person's face to visualize what he or she might look like at some later point in time or showing "before-and-after" views of the same subject. The possibilities are limited only by your imagination. There's certainly no lack of subject matter—just look around you. It's a great, big world out there, one that can be morphed into a...big blue marble, a bowl of cherries, an oyster, a basketball, a...you get the idea. So grab a morphing package, load it on your PC and go about changing the world to your heart's content! ■

Products Mentioned

PhotoMorph 2, $149.95
North Coast Software, Inc.
PO Box 459
265 Scruton Pond Rd.
Barrington, NH 03825
Tel.: 603-664-6000
CIRCLE NO. 124 ON FREE INFORMATION CARD

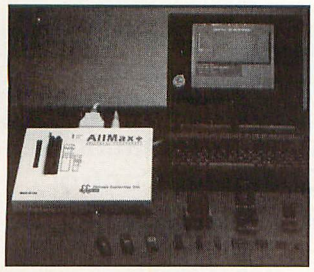
Morph 2.5, $99
Gryphon Software Corporation
7220 Trade St., Ste. 120
San Diego, CA 92121
Tel.: 619-536-8815
CIRCLE NO. 125 ON FREE INFORMATION CARD

Vista Pro 3.0, $149.95
Virtual Reality Laboratories, Inc.
2341 Ganador Ct.
San Luis Obispo, CA 93401
Tel.: 805-545-8515
CIRCLE NO. 126 ON FREE INFORMATION CARD

Digital Morph, $149
HSC Software
6303 Carpinteria Ave.
Carpinteria, CA 93013
Tel.: 805-566-6200
CIRCLE NO. 127 ON FREE INFORMATION CARD

Universal Device Programmer

The AllMax+ from Electronic Engineering Tools is a universal programmer that supports a

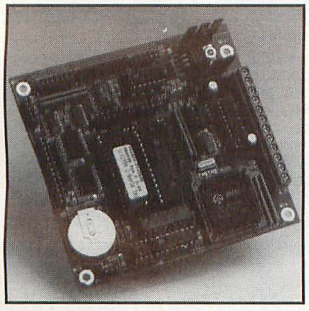


wide variety of programmable devices and tests digital ICs and static and dynamic memory. The programmer connects to a PC through a parallel port. $745. *Electronic Engineering Tools, 544 Weddell Dr., Ste. 6, Sunnyvale, CA 94089; tel.: 408-734-8184; fax: 408- 734-8185.*

CIRCLE NO. 25 ON FREE CARD

Miniature Controller

Z-World Engineering's Little Genius C-programmable miniature controller features 14 digital inputs and 12 digital outputs, EEPROM, battery-



backed RAM and real-time clock, programmable timers, 9-MHz processor clock, watchdog timer and power-fail interrupt and an expansion port.

Little Genius is expandable through the Z-World PLCBus. If the bus isn't used for expansion, it can be used for eight additional CMOS-level inputs. $149. *Z-World Engineering, 1724 Picasso Ave., Davis, CA 95616; tel.: 916-757-3737; 916-753-5141.*

CIRCLE NO. 26 ON FREE CARD

Software

Duplicate Finder

Data Discovery's *TrueList* 2.0 identifies and removes probable duplicate addresses from mailing lists. The program runs under *Windows* and works with ASCII text or *dBASE*-format mailing lists. $149. *Data Discovery, Inc., Overland Park, KS; tel.: 800-808- 3838.*

CIRCLE NO. 27 ON FREE CARD

Windows Solver

TK Solver for Windows from Universal Technical System is a math modeling program that lets you solve numerical problems stated in plain language without programming codes or rewriting equations to isolate unknown variables. *Windows* functionality and help-system enhancements make the latest release of this program more versatile, quick and easy to use.

TK Solver includes a library of mathematical and statistical programs with more than 200 prefabricated models for solving simple to complex problems. $595. *Universal Technical Systems, Inc., 1220 Rock St., Rockford, IL 61101; tel.: 815-963-2220; fax: 815-963-8884.*

CIRCLE NO. 28 ON FREE CARD

Voice for DOS

Simply Voice for DOS is voice-recognition software from Interactive Products that provides command and control via voice for all popular software applications. It operates as a speaker-dependent, word-isolated system and can handle up to 150 words or short phrases in an active vocabulary. Additional vocabularies can be swapped in by voice command. Each trained word is designed to activate corresponding keyboard entries or macros. $79.95. *Interactive Products, Inc., 1600 Valley River Dr., Ste. 170, Eugene, OR 97401; tel.: 503-341-4964; fax: 503-341-4965.*

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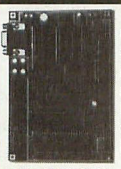

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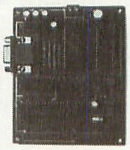

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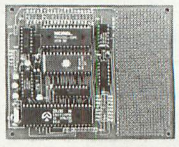

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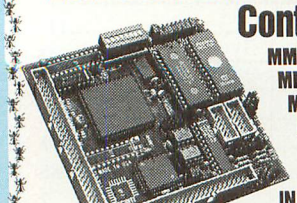

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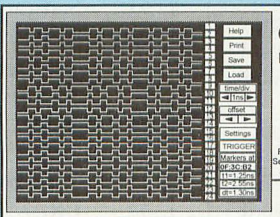

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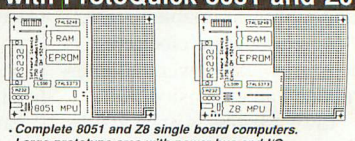

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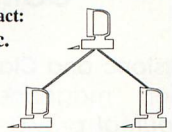

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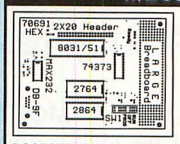

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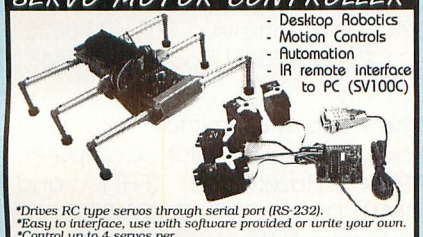

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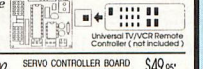

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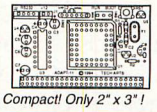

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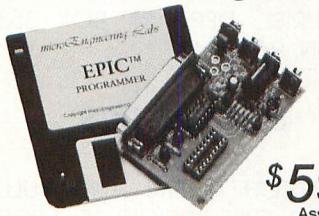

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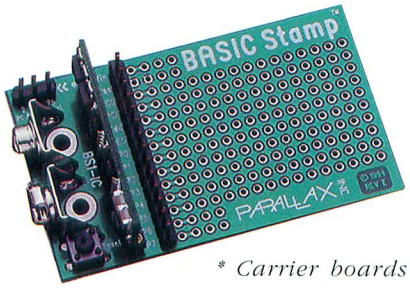

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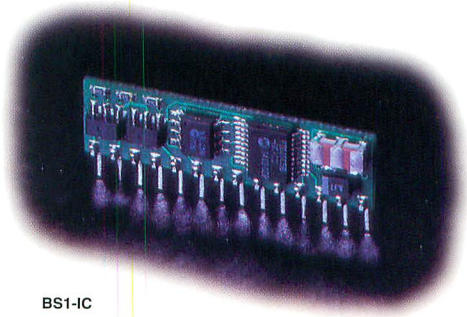

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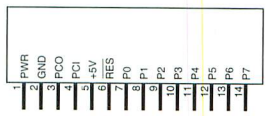

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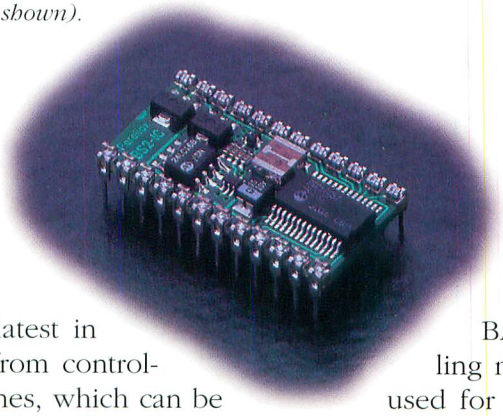

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ATN	3	22	$\overline{\text{RES}}$
GND	4	21	+5V
P0	5	20	P15
P1	6	19	P14
P2	7	18	P13
P3	8	17	P12
P4	9	16	P11
P5	10	15	P10
P6	11	14	P9
P7	12	13	P8

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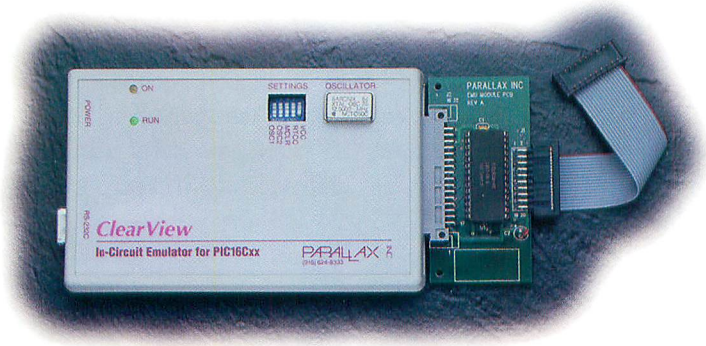

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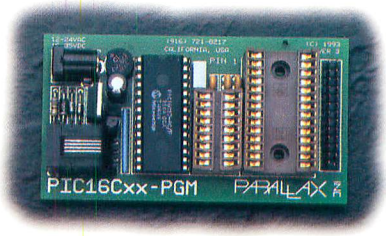

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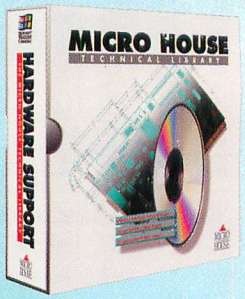

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